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ORIGINAL ARTICLES.

I.—Sir Richard Owen, K.C.B., M.D., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., V.P.Z.S., Pres. Pal. Soc., Assoc. Inst. France.

(With a Portrait.)

In recording the regret which the world of science feels at the loss of Sir Richard Owen, we seem to stand in a more intimate and personal relation to him than many others, from the fact, that he was not only one of the early and frequent contributors to the Geological Magazine, but also was the official colleague of the writer during a quarter of a century.

Born at Lancaster on the 20th July, 1804, Owen was destined for the Medical profession, and passed from school to college in Edinburgh, where he matriculated in 1824, passing his medical examinations and becoming a member of the Royal College of Surgeons in 1827.

About this time, his love of science was stimulated by a short residence in Paris, during which he attended the lectures of the illustrious Cuvier, then at the zenith of his greatness. After a brief period of private practice, he gladly accepted the position of Assistant-Curator of the Hunterian Collections in the College of Surgeons, conferred upon him on the recommendation of the celebrated Dr. Abernethy. Here he revelled in the examination of the uncatalogued preparations of Dr. John Hunter, the most distinguished surgeon of the last century.[1] He undertook the preparation of a series of Descriptive and Illustrated Catalogues of the specimens of Physiology and Comparative Anatomy; and later on, those of Natural History, Osteology, and Fossil Organic Remains preserved in the College Museum (1833–40). In 1834 Owen was elected to the Chair of Comparative Anatomy in St. Bartholomew's, carrying the title of "Professor;" and in 1835 married the daughter of Mr. William Clift, Curator of the Hunterian Museum, his old chief officer. In the following year he gained the fellowship of the Royal Society and the post of Hunterian Professor in the Royal College of Surgeons, which he held until his appointment to be Superintendent of the Departments of Natural History in the British Museum in 1856.

Whilst engaged upon the large series of Catalogues for the College of Surgeons' Museum, Owen obtained permission to dissect such

[1] In this task he was assisted by his life-long friend Mr. (now Sir James) Paget.

animals as the Zoological Society's menagerie could from time to time supply, and this enabled him to contribute a long succession of most valuable papers to the Proceedings of the Society's Journal and elsewhere.

Valuable as are these memoirs, we naturally turn to Owen's palæontological labours as affording the matter of greatest interest to geologists.

Most interesting of these is his Monograph on the Fossil Mammals of the Mesozoic Formations (1871), which, although late in date, embodies much of his earlier work, and contains thirty species from British localities, such as Frome, Stonesfield, and Purbeck. This, together with his memoirs on the Red Crag Cetacea (1869); the Reptilia of the London Clay (1848–56, and 1880); of the Cretaceous Formations (1851–64); of the Wealden and Purbeck (1871–79); of the Kimmeridge Clay (1859–69); of the Mesozoic Formations (1873–77); forming a large series of Monographs, have all appeared in the annual volumes of the Palæontographical Society, embracing descriptions of 139 species of reptilia and nine species of cetacea.

Of his contributions to scientific societies it would be quite beyond the scope of this brief notice to give a detailed account.[1] His Memoir on the Pearly Nautilus appeared as early as 1832; his paper on a Belemnite from the Oxford Clay in 1844; his "History of British Fossil Mammals and Birds," in 1846; his "History of British Fossil Reptiles," 1849–51; his Palæontology in 1860, and 2nd Edition (1861). Among his Memoirs on foreign fossils may be mentioned that on the gigantic extinct sloth *Mylodon* (1842); on the *Megatherium* (in 1860); his series of Memoirs on the "extinct Marsupialia of Australia;"[2] the "extinct Birds of New Zealand;"[3] his memoirs on the *Archæopteryx*,[4] and the Dodo,[5] and on the fossil reptilia of South Africa,[6] are the most important. Of the twenty papers in this MAGAZINE the first appeared in 1865, and the last in 1883; the series form good examples of his short papers on palæontological subjects; and nearly every one is the description of some good fossil which had been brought to his notice.

In 1856, the question of the severance of the Natural History Departments of the British Museum was before Parliament, and after a prolonged discussion, Mr. Panizzi (aided, no doubt, by Lord Palmerston) held his position of Principal Librarian and *chief Executive Officer* of the British Museum, and Professor Owen was appointed Superintendent of the Natural History Departments, but without a separate administration. This enabled him to escape from all official routine, save one annual report, and signing the Keepers' monthly reports, and with now and then a special word of recommendation. He also gave a course of 12 lectures annually in the Lecture-Theatre of the Jermyn Street Museum; but only for a few

[1] The Royal Society's Catalogue of Scientific papers puts the number at 360; which does not include his works published separately.

[2] Phil. Trans. Royal Soc.

[3] Trans. Zool. Soc. London.

[4] *Ibid.*

[5] *Ibid.*

[6] Published by the Trustees of the British Museum.

years. This will explain why at this period of Owen's career, from 1856 to 1880, he was so prolific in papers and memoirs.

The event of the Great Exhibition brought Owen (as the President of one of the Juries) under the notice of the Prince Consort, and he speedily became a recognised favourite with the Queen, and was frequently requested to deliver lectures on Natural History before Her Majesty and the Royal family. By the Queen's favour he received a residence, Sheen Lodge, Richmond Park, and a Civil List pension, both of which he enjoyed until the time of his death. He was President of the British Association at Leeds, in 1858; and was succeeded by the Prince Consort at Aberdeen, in 1859.

Although (away from Monte Carlo) every one is too well-educated to believe in "being born under a lucky star," nevertheless, we may safely affirm that Owen was born at a most fortunate time, and in a century marked by the greatest progress in science, commerce, and literature that the world has ever known.

Owen lived on into the new era of steam-locomotion, of telegraphs, of cheap printing, of good illustrations, of higher education; indeed, it is n t too much to assert, that Owen like his contemporaries, Herschell, Faraday, Lyell, and Darwin (together with many others), helped to bring on this great advance in civilization.

But for the vast amount of solid anatomical and palæontological work which Owen had accomplished, much of Lyell's work could not have been effected, and the theory of Natural Selection and the Origin of Species could not have appeared so soon. Indeed, when in the end of 1859, Darwin's first edition of the "Origin of Species" appeared, Owen claimed to have enunciated similar views *long before*. Nevertheless, when Darwin begged to be permitted to quote Owen as a supporter of his views, or as favourable to them, he declined to accept them, and classed them as a new phase of Lamarckianism which we should most of us live to see die a natural death. This was not generous, and contrasts strongly with Lyell, who having held to the old uniformitarian views for many years, and to the fixity of species, abandoned his old views, and accepted the new doctrines with an open mind.

The real secret, perhaps, lay in some anxiety felt by Owen lest he should lose popularity and give offence to the higher clergy, and to my lords, and (as the Catechism expresses it) "to those who are put in authority over us!"

The success that attended him in his long life resulted from a combination of circumstances. Everyone will readily admit the fact of Professor Owen's extraordinary genius, his sagacity in interpretation, and his remarkable ability as a lecturer; but behind these he owed very much to his indomitable energy and power of sustained work; to his marvellous flow of language, to his vigorous bodily health, and, in controversy, not a little to his cleverness both in defence and attack. His courteous manners, when dealing with the general public, were proverbial, and also the marked attention which he paid to the rank of the individual.

He was fortunate in belonging so early in the century to the medical profession, then standing almost alone as a body of most intelligent and able men of science (for the eminent chemists and engineers have arisen since). They could not spare time to criticize Owen's work, but they were as a body most generous and appreciative, and but few ever opposed him. He was happy in being appointed to the charge of the Hunterian Collections, for so many years kept back from publication by Sir Everard Home, who had promised to edit the Hunterian MSS. also, but failed to do so. Add to this his special opportunities and facilities for comparative anatomical studies, afforded by the Zoological Society; but most of all, to his choice of palæontology, then a virgin field of research, over which he was free to travel far and wide, and to reap for years golden harvests almost unchallenged by other workers. So unused was he to rivalry in his special lines of research that when younger men, like Falconer, Busk, G. R. Waterhouse, Huxley, and others, took the field, he became most keen to watch the "quarry," and when espied, even from afar, Owen eagle-like, would pounce upon and carry off the coveted spoil; indeed his whole nature seemed transformed in the presence of a new and undescribed fossil, so eager was he to take the field and describe it, or (as frequently happened) if the new discovery arrived at an unpropitious moment, he was equally eager to conceal his treasure from the curious and inquiring eyes of youthful aspirants.

It is pleasant to turn from the small struggles and weaknesses, which great men are apt, like lesser ones, to betray, and remember the solid advantages which Owen gained for us by long years of continuous and earnest work; even his very love of high and exalted personages has resulted in solid gain to science in the acquisition for the nation, through his persistent advocacy for twenty years, of the magnificent building in Cromwell Road, in which are now preserved the entire series of Natural History Collections, formerly overcrowded and inadequately housed in the old Museum Buildings in Great Russell Street.

This notice would be still further incomplete were we to omit to remember the fact that Owen was able to shake off his scientific aspect and become, at Sheen Lodge, the amiable host and the accomplished guide to the beauties of his own wilderness garden at the back of Sheen Lodge, or to the wider and more extensive charms of Richmond Park. As a raconteur Professor Owen was inimitable. He had delightful stories to tell of Thackeray, of the Emperor of Brazil (who came out from London to visit him at 7 o'clock in the morning), of the gracious visits paid him by the Royal family; of his winters spent in Egypt; one winter in the company of H. and H.R.H. the Prince and Princess of Wales. He would tell of his visit to Italy to attend the Scientific Congress at Bologna, his trip to Vesuvius, and his visit to H.M. Bomba, king of Naples (now happily dethroned and gone) : or of his visit to the Vicomte de Lastic, to secure for the Museum the grand

collection of weapons, and human and animal remains from the cavern of Bruniquel in the Valley of the Aveyron.[1]

He loved to recall the series of Lectures given before the Queen in the "White Drawing Room" at Windsor, when he astonished the Venerable Dean of Windsor with the information that "tadpoles" turned into toads and frogs.

There too were pleasant meetings (not for the promotion of science but of harmony), both at Lincoln's Inn Fields, and at Sheen Lodge, and also at the houses of Dr. Farre, and Sir James Paget, when quartette parties met to discuss sweet music; when Owen and Waterhouse played on the violoncello and the violin, Mrs. Waterhouse and her daughter on the piano, whilst Paget, Farre, and others joined in. Alas! they are nearly all gone over to the great majority: into the land of the great departed, into the silent land—yet not silent are the memories of their survivors who can recall some of those pleasant meetings long ago.

Upon his retirement from office H.M. the Queen graciously conferred upon him the title of Sir Richard Owen, K.C.B., but in our memories he will still remain "Professor Owen."

With gradual decrease of his bodily powers, he passed away on the 18th Dec., 1892.

We stood by Sir Richard Owen's grave on December 22nd, in the quiet churchyard of the little village of Ham, where he was laid to rest, by his own desire, beside his loving and faithful wife.

To-day (January 21st) has witnessed one of the most representative gatherings of men of science at the Royal Society which has been seen for years. H.R.H. the Prince of Wales occupied the chair, supported by H.S.H. the Duke of Teck, Lord Kelvin, and Lord Playfair; Sir James Paget; Sir A. Clark; Sir Frederick Leighton; Prof. Huxley; Sir A. Geikie; Sir John Evans; Prof. Stewart; Sir William Flower, Mr. W. Percy Sladen, Dr. Günther, Mr. Carruthers, Mr. Fletcher, Prof. F. J. Bell, Mr. E. A. Bond, Mr. Thompson, Sir H. Acland, Prof. Michael Foster, Dr. P. L. Sclater, Mr. T. Bryant, Sir George Stokes, Sir Frederick Abel, Prof. T. R. Jones, and more than 200 others were present, to consider the desirability of commemorating, by some suitable memorial, the eminent services of Sir Richard Owen in the advancement of our knowledge of the sciences of Anatomy, Zoology, and Palæontology. The first proposition, that there be a memorial, was moved by Lord Kelvin, Pres.R.S., and seconded by the Rt. Hon. T. H. Huxley, F.R.S. The second, that the memorial be in the form of a marble statue, to be offered to the Trustees, to be placed in the Natural History Museum, which Owen did so much to establish, was moved by H.S.H. the Duke of Teck and seconded by Sir William Flower. Mr. P. Lutley Sclater moved that a Catalogue of Owen's works be also prepared and printed and given to each subscriber. Sir James Paget nominated the committee, and Mr. Bryant, President of the Royal College of Surgeons, seconded the motion. Sir Andrew Clark, President of the Royal College of Physicians, nominated the Executive

[1] For which see the Phil. Trans. Roy. Soc. for June, 1864, and Abstract, GEOL. MAG., 1864, pp. 137–138.

Committee, and Sir John Evans, seconded the motion. Lord Playfair also spoke. Sir Henry Acland moved a vote of thanks to H.R.H. the Prince of Wales for graciously taking the chair and consenting to preside over the Executive Committee. Prof. Michael Foster seconded the the motion.

The speeches were all kindly, generous, and eulogistic, and admirably delivered. The Prince spoke in the kindest manner of Sir Richard Owen as a personal and valued friend. The subscription list is already making excellent progress, and everything promises success to the Owen Memorial. Sir James Paget is Chairman, Sir William Flower, Treasurer, and Mr. W. Percy Sladen Secretary.

The following are the titles of Professor Owen's contributions to the GEOLOGICAL MAGAZINE, 1865–1886:

Descriptions of some remains of an Air-breathing Vertebrate (*Anthrakerpeton crassosteum*, Owen) from the Coal-shale of Glamorganshire. (GEOL. MAG. 1865, Vol. II. pp. 6–8, Plates I. and II.)

Descriptions of portions of Jaws of a large extinct Fish (*Stereodus Melitensis*, Ow.), probably a 'Cycloid,' with 'Sauroid Dentition,' from the 'Middle Beds of the Maltese Miocene.' (*Ibid.* 1865, Vol. II pp. 145–147.)

On a New Genus (*Miolophus*) a Mammal from the London Clay. (*Ibid.* 1865, Vol. II. pp. 339–341, Plate X.)

Review of P. J. Van Beneden's "Recherches sur les Squalodons," (*Ibid.* 1865, Vol. II. pp. 405–411.)

On *Macrauchenia Patachonica*. (*Ibid.* 1865, Vol. II. pp. 520–523.)

On a Genus and Species of Sauroid Fish (*Thlattodus suchoïdes*, Ow.) from the Kimmeridge Clay of Norfolk. (*Ibid.* 1866, Vol. III. pp. 55–57, Plate III.)

On a Genus and Species of Sauroid Fish (*Ditaxiodus impar*, Ow.) from the Kimmeridge Clay of Culham, Oxfordshire. (*Ibid.* 1866, Vol. III. pp. 107–109, Plates IV. and V.)

Description of part of the Lower Jaw and Teeth of a small Oolitic Mammal (*Stylodon pusillus*, Ow.). (*Ibid.* 1866, Vol. III. pp. 199–201, Plate X.)

On the Mandible and Mandibular Teeth of Cochliodonts. (*Ibid.* 1867, Vol. IV. pp. 59–63, Pls. III. and IV.)

Letter from Professor Owen. (*Ibid.* 1867, Vol. IV. pp. 424–425.)

On the Distinction between *Castor* and *Trogontherium*. (*Ibid.* 1869, Vol. VI. pp. 49–56, Pl. III.)

Description of a Great Part of a Jaw with the Teeth of *Stophodus medius*, Ow., from the Oolite of Caen in Normandy. (*Ib.* 1869, Vol. VI. pp. 193–196, Pl. VII.)

Supplementary Note to the above. (*Ibid.* pp. 235–236.)

Note on the occurrence of Remains of the Elk (*Alces palmatus*) in British Post-Tertiary Deposits. (*Ibid.* 1869, Vol. VI. p. 389.)

Notes on two Ichthyodorulites hitherto undescribed. (*Ibid.* 1869, Vol. VI. pp. 481–483.)

Notice of some Saurian Fossils discovered by J. H. C. Hood, Esq., at Waipara, Middle Island, New Zealand. (*Ibid.* 1870, Vol. VII. pp. 49–53, Pl. III.)

Letter from Prof. Owen. (*Ibid.* 1873, Vol. X. p. 478.)

On an Outline of the Skull, Basal View, of *Thylacoleo*. (*Ibid.* 1883, Vol. X. p. 289, Pl. VII.)

Letter from Prof. Owen. (*Ibid.* 1884, Vol. XXI. p. 286.)

Letter from Prof. Owen. (*Ibid.* 1886, Vol. XXIII. p. 140). H.W.

II.—ON A NEW PALÆONISCID FISH, *MYRIOLEPIS HIBERNICUS*, SP. NOV. FROM THE COAL-MEASURES, CO. KILKENNY, IRELAND.

(PLATE III.)

By R. H. TRAQUAIR, M.D., F.R.S., F.G.S.

OF the fossil fish now described I know only two specimens, of which one is in the Manchester Museum, Owen's College, the other in the Museum of Practical Geology, Jermyn Street, London.

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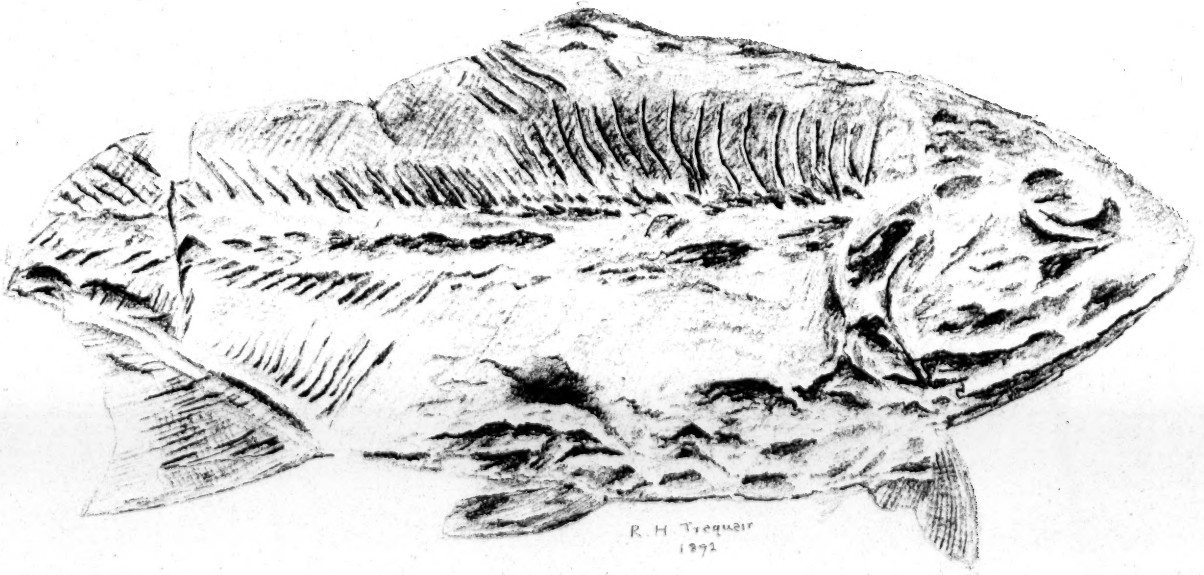


MYRIOLEPIS HIBERNICUS.—TRAQUAIR, SP. NOV.

Both are from the Coal-measures, Jarrow Colliery, Co. Kilkenny, Ireland.

The Manchester specimen (Pl. III.) is imperfect, being broken off about half an inch behind the anal fin; the dorsal fin is also deficient; but its position is indicated by the subjacent fin-supports. The pectoral, ventral and anal fins are present.

The measurements are as follows:—

Entire length of the specimen, so far as preserved ...	7½ inches.
From tip of snout to origin of pectoral fin	2 ,,
,, ,, ,, ventral fin	4 ,,
,, beginning of pectoral to beginning of ventral...	2¼ ,,
,, ,, ventral to beginning of anal ...	1⅞ ,,
Depth of body at origin of ventral fin	3 ,,
Length of head to posterior margin of gill cover ...	2¼ ,,

The head shows scarcely any detail, though it is at once apparent that its structure was typically Palæoniscoid, with anteriorily placed orbit, oblique suspensorium, and wide gape. Its length is contained 3½ times in the total up to the tail pedicle, where the specimen is broken off.

The rather deeply fusiform body is shown to have been covered with rhombic scales which were exceedingly small in proportion to the size of the fish, those in the front of the flank measuring only $\frac{1}{20}$ inch in height and breadth; only feeble traces of a striated ornament are observable on them. Some large median scales are seen in front of the dorsal fin.

The scales must also have been very thin, as they have allowed the contour of the bones of the internal skeleton to be tolerably distinctly indicated through them—these indications being in the form of impressions of vertebral arches and spines, and of inter-spinous bones or fin-supports. The skeleton as thus exhibited is typically palæoniscoid.

The fins which are preserved are of moderate size, even small for the size of the fish. The pectoral is not completely shown, though enough is preserved to show that it consisted of numerous, fine, closely set rays which were also closely articulated, the principal rays being also jointed up to their origins. The ventral fin is small and narrow, with fine rays of a character similar to those of the pectoral. The anal is triangular-acuminate, its hinder margin somewhat concavely excavated, and consists likewise of numerous fine, closely-set rays, whose transverse articulations are extremely close. The dorsal fin is not preserved, but judging from the position of its supporting ossicles, it must have occupied a position nearly opposite the interval between the ventral and anal.

The specimen in the Museum at Jermyn Street, London, represents a slightly larger specimen, the length from the front of the head to the posterior termination of the base of the anal fin being 8½ inches. Here the specimen is broken off, nearly at the very place where the same has happened to the specimen at Owen's College. However, the dorsal fin is preserved and shows a contour and structure similar to those of the anal in both specimens.

There can be no doubt that this fish is new to science as a species, the only question remaining for consideration is that of the genus to which it should be referred. The Carboniferous genera to which it seems most closely allied are *Elonichthys* and *Acrolepis*; but it is excluded from both by the very small size and thinness of the scales, and more especially from *Acrolepis* by the rays of the pectoral fin being articulated to their origins.

So far as the smallness of the scales and the arrangement of the fins is concerned, there is a very considerable resemblance between the present fish and the early Mesozoic genus *Myriolepis*, as described originally by the late Sir Philip Egerton,[1] and more recently by Mr. A. Smith Woodward.[2] But the condition, as to articulation, of the rays of the pectoral fin of *Myriolepis* does not seem yet to be known, and should its principal rays turn out not to be articulated up to their origins as in the present fish, there is little doubt that a new genus must be constituted for the reception of the latter.

Though it does strike one as slightly improbable that the same genus of Palæoniscidæ should persist from Carboniferous to Triassic times, I feel the setting up of new genera in this already most extensive family without absolute demonstration of its necessity becoming more and more distasteful. I therefore refer this interesting Irish Carboniferous palæoniscid to the genus *Myriolepis*, under the name of *M. Hibernicus*, though it must be distinctly understood that this reference is only provisional and awaiting confirmation, or the reverse, by the further development of our knowledge of the type species of the genus.

My thanks are due to Prof. Boyd Dawkins and Mr. Hoyle for the opportunity of examining and describing the specimen of this very interesting Carboniferous fish, which is preserved in the Museum at Owen's College, as well as to Sir Archibald Geikie for permission to examine that at Jermyn Street.

EXPLANATION OF PLATE III.

Myriolepis Hibernicus, Traquair, Coal-measures, Kilkenny, reduced one-fifth.

III.—On *Palæosaccus Dawsoni*, Hinde, a New Genus and Species of Hexactinellid Sponge from the Quebec Group (Ordovician) at Little Métis, Quebec, Canada.

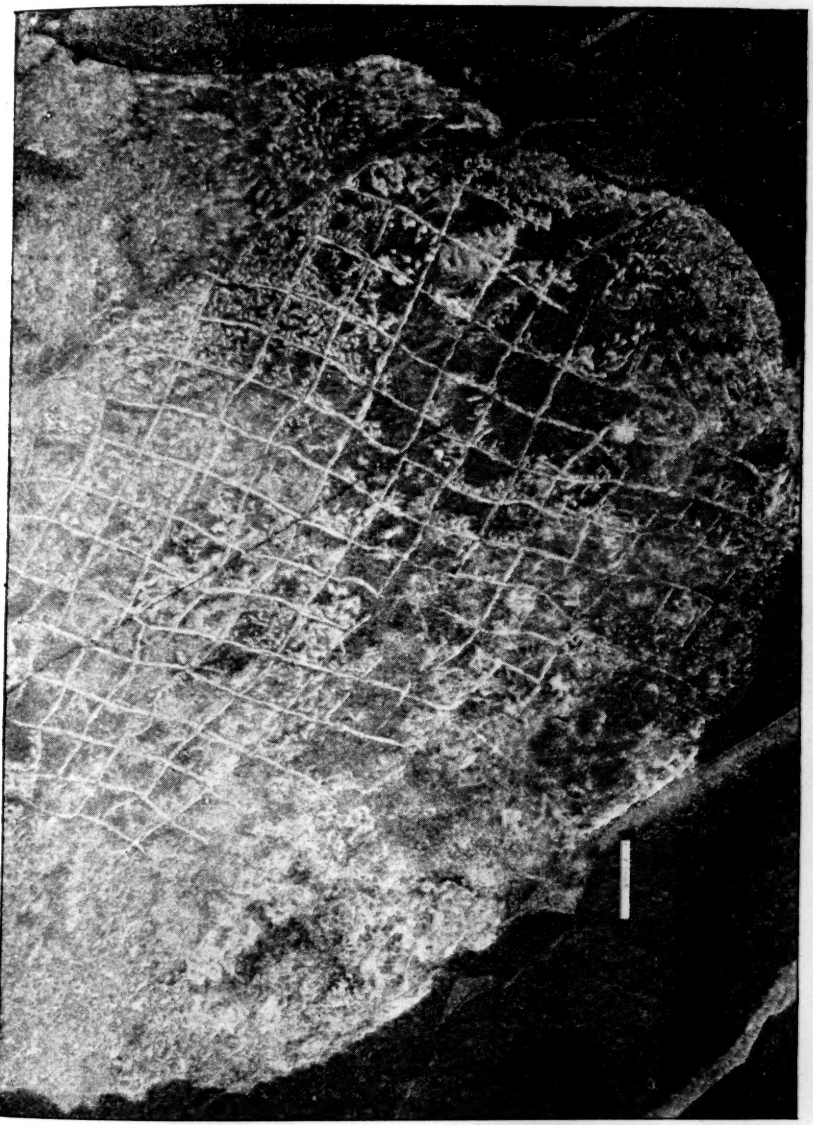
By George J. Hinde, Ph.D., F.G.S.

(PLATE IV.)

In 1887 and 1888, Sir J. W. Dawson discovered in dark carbonaceous shales of the Quebec group, exposed at Little Métis, on the north shore of the Lower St. Lawrence, some thin bands of rock largely filled with the remains of siliceous sponges, and similar fossils were found to be sparsely scattered in adjacent beds through a vertical thickness of forty feet. This discovery of an abundant sponge fauna at so low an horizon, in rocks previously considered

[1] Quart. Journ. Geol. Soc. 1864, vol. xx. p. 2.

[2] "The Fossil Fishes of the Hawkesbury Beds at Gosfort" (New South Wales), pp. 7–11.



Palæosaccus Dawsoni, Hinde.

A New Genus and Species of Hexactinellid Sponge from the Quebec group (Ordovician), Little Métis, Canada.

Reduced to $\frac{3}{7}$ the diameter.

to be unfossiliferous, proved to be of considerable importance in showing the character of these organisms which flourished at this early epoch, and though the condition of the specimens was far from perfect, Sir J. W. Dawson was enabled from the materials obtained to describe eleven new species, which were placed in the genera *Protospongia*, *Cyathospongia*, *Acanthodictya*, *Hyalostelia*, *Lasiothrix*, and *Halichondrites* (Trans. Royal Soc. Canada, vol. vii. section iv. 1889, pp. 31–55, pl. iii.). With the exception of the species referred to the three last-named genera, of which the relationships are at present doubtful, these sponges belong to the group of Lyssakine Hexactinellids, of which the earliest traces are found in the Cambrian strata of this country and elsewhere.

Since 1888, Sir J. W. Dawson has improved the opportunity afforded by passing the summer vacation in Little Métis in energetically working at fresh excavations in the beach and cliff sections at that place, with the result of obtaining many fresh specimens, which confirm the characters of the forms already described. This last summer his search was further rewarded by finding a specimen of a new and very distinct form, which he has done me the honour to entrust to me for description. As is the case with all the other sponges preserved in these black shales, this specimen is now in a flattened or compressed condition on the surface of the rock, and has the general appearance of a piece of coarse open network. Unfortunately the entire specimen could not be secured, and the portion on the slab, shown in the accompanying photograph, which has been reduced to about $\frac{3}{7}$ the diameter of the original, probably represents less than one-half of the whole form. The original siliceous structure of the skeleton has now been replaced by pyrites, so that the form and dimensions of the spicules are but imperfectly shown. The same mineral change has affected all the other sponges in these beds, and, in fact, it is of very general occurrence wherever siliceous sponges are embedded in similar black carbonaceous shales. The specimen evidently belongs to a new genus, which is proposed below.

Palæosaccus,[1] gen. nov.

Cylindrical or sack-like sponges, with thin walls of rhombic meshes. The strands of the mesh-work consist of fascicles of slender rods, cruciform, and, perhaps, five-rayed spicules; the interspaces are either open or covered with a thin layer of irregularly disposed rods and cruciform spicules. No anchoring spicules have been found in immediate connection with the sponge, but there are in the same beds elongated anchoring spicules with ornamented spiral ridges which may perhaps belong to it.

From *Cyathophycus*, Walcott (=*Cyathospongia*, Dawson, non Hall), which appears to be nearest allied, this genus is distinguished by the rhombic character and large size of the mesh-work; the generally similar structure both of the longitudinal and transverse strands of the mesh, and the greater development of rod-like spicules. The

[1] παλαιος, ancient; σακκος, coarse cloth, sack, strainer.

same features likewise differentiate it from *Plectoderma*, Hinde, and *Phormosella*, Hinde.

PALÆOSACCUS DAWSONI, sp. nov. (Pl. IV.).

Sponge of large size, apparently cylindrical in its complete form; the part preserved consists of a flattened portion of the wall-surface more than a foot in diameter; both the upper and the basal portions of the sponge are wanting. The rhombic meshes of the wall vary from 14 to 20 mm. in width, the average width is nearly 17 mm. The strands of the mesh mostly consist of very slender rod-like threads apparently simple, which are loosely arranged, generally parallel with each other. At the angles of the mesh there are, very frequently, if not in all cases, stouter cruciform, or perhaps five-rayed spicules, and slender cruciform spicules are likewise intermingled with the rods in the strands. In the interstices of the mesh-work, and apparently exterior to it, there is, in some portions of the sponge, a thin open layer, composed of slender rods and cruciform spicules, overlapping each other without definite arrangement. It is possible that this layer may have formed the outer surface of the sponge, for the spicules are of the same character as those of the strands of the mesh, but on this point there is some uncertainty, for the interstices in some parts of the wall are now quite open, and without this spicular layer.

Some uncertainty also arises respecting the anchoring appendages of the sponge, since the basal portion is wanting, and no anchoring spicules are found in immediate contact with the specimen, but on the surface of the same rock-bed in which it occurs, there are some peculiarly ornamented spiral rods which may belong to this species. Sir J. W. Dawson has given a diagrammatic representation of one of these spicules (*op. cit.* p. 49, fig. 20) which appears as if it consisted of several very minute filaments spirally twisted together, like the strands of a rope. Each filament has a row of projecting tubercles which in the rod are definitely arranged in quincunx, so that the general ornamentation is very striking. At the distal end the rods are slightly curved, and the raised lines are straight instead of spiral. As with the other spicules, these anchoring forms are now of pyrites, and it is not easy to decide whether they result from the amalgamation of slender strands or whether the spiral tuberculated ridges are merely the surface ornaments of a single rod-like spicule. Be this as it may, we cannot as yet state positively that these peculiar anchoring spicules really belong to the present species.

So far as can be at present determined this sponge appears to have consisted simply of a delicate thin sack or cylinder of spicular strands forming a rhombic mesh, with possibly a thin outer spicular layer. There is no evidence that the sack inclosed an inner spicular tissue, and probably this thin wall represents its entire skeleton. A similar condition seems to have been present in *Protospongia*, *Cyathophycus* and probably also in *Dictyophyton* and the genera allied to it, but in none of these do we find the structure on such a large scale as in the present form.

I have much pleasure in associating the name of this remarkable sponge with its discoverer, Sir J. W. Dawson, F.R.S.

Distribution.—Shales of the Quebec Group, probably near the base of the Lévis Division, at Little Métis, Lower St. Lawrence, Province Quebec.

EXPLANATION OF PLATE IV.

Palæosaccus Dawsoni, Hinde; a portion of the mesh-work of the sponge-wall exposed on the surface of a slab of black shale. Reduced to $\frac{2}{3}$ the diameter. From the Quebec Group (Ordovician) at Little Métis, Canada.

IV.—On the So-called Spilites of Jersey.

By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S., and Miss Catherine A. Raisin, B.Sc.

ABOUT one quarter of the Island of Jersey is occupied by argillites or fine grits, often of a greenish grey colour referred by French geologists to the "Phyllades de St. Lo." They are, therefore, if not equivalent to the Lower Cambrian beds of Britain, slightly more ancient.[1] In close association with these, but according to Prof. de Lapparent, belonging rather to the upper part of the group, occur certain more or less porphyritic rocks, as to the origin of which different opinions have been entertained. M. Noury in his useful "Géologie de Jersey" describes them under the name of "spilites." While admitting that in many respects they exhibit the characters of an eruptive rock, he concludes, after an elaborate discussion, that they are metamorphosed argillite, the change being primarily due to the "porphyres pétrosiliceux;" the felspar crystals, however, he thinks, may be attributed to the action of the diorite.[2] Prof. de Lapparent, in a paper published in 1884, briefly refers to these "spilites" as amygdaloidal melaphyres; and again, in 1891, expresses the opinion that they are igneous rocks (tuffs, breccias, etc.), calling them porphyrites.[3] But as the point is one of considerable interest, the notes and conclusions arrived at in the summer of 1888, by one of the writers, may be worth placing on record.

A few words are needed to explain the delay and the joint authorship of this paper. Prof. Bonney in 1888 had the advantage of spending a week in Jersey in company with the Rev. E. Hill, who has added so much to our knowledge of the Channel Isles.[4] They examined with some care the mass of "spilite" at Mont

[1] Bull. Soc. Géol. de France, vol. xvi. p. 412, A. Bigot; and Bull. du Lab. de Géol. de la Faculté des Sciences de Caen., A. Bigot, December, 1890, p. 11.

[2] Géologie de Jersey, 1886, M. Noury, pp. 59, 61, 63.

[3] Bull. Soc. Géol de France, 1884, tome xii. p. 288; Q.J.G.S., 1891, vol. xlvii. p. 36; Comptes Rendus, 1890, vol. 111, p. 543. After the completion of the manuscript of this paper, we received a copy from Prof. de Lapparent of his newly published "Note sur les Roches Eruptives de l'Ile de Jersey" (Ann. de la Soc. Scientif. de Bruxelles, tome xvi. 2e partie) in which these "spilites" are described. But as he refers chiefly to other quarries and enters on the whole into fewer details than we have done, the results of our work may be still of some little interest, at any rate to English readers.

[4] Q.J.G.S. 1884 vol. xl. p. 404; Q.J.G.S. 1887 vol. xliii. p. 322; Q.J.G.S. 1889 vol. xlv. p. 380; Q.J.G.S. 1892 vol. xlviii. p. 122.

de l'Ouest,[1] close to St. Heliers, for they felt doubts as to the correctness of M. Noury's view of its origin, and were struck by its occasional resemblance to some of the rock at Bardon Hill, Leicestershire, on the study of which they were then engaged. In hopes that it might throw light on some of the difficulties presented by that rock, specimens were collected, slides from which were examined by Prof. Bonney soon after his return to England. So far as concerned the immediate purpose the result was disappointing, for the resemblances proved to be comparatively superficial and the structures presented few difficulties. He was, however, convinced that M. Noury's interpretation was erroneous. A brief notice would have been published almost immediately, but more pressing work has again and again obliged him to leave the slides untouched in his cabinet, for want of time to search through the literature of the subject and to study the more minute microscopic details. So they would be still lying, were it not for the kindness of Miss C. A. Raisin, who has undertaken that, the more laborious part of the work.

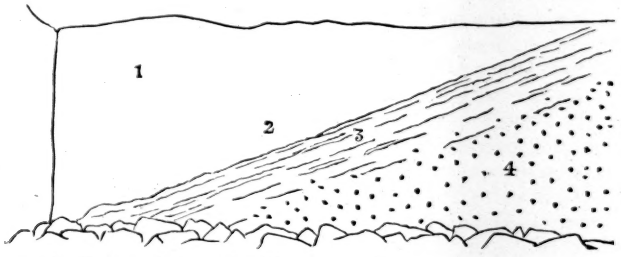
In the walls of gardens on the northern outskirts of St. Heliers blocks of "spilite" are common, one being a conspicuously porphyritic variety. In this, crystals of plagioclase felspar, rather tabular in shape, sometimes about $\frac{3}{4}''$ in length, occur in a dark purplish matrix. Prof. Bonney was informed that this variety was obtained from a quarry situated, as nearly as he can place it, on the east side of a valley to the south-east of the Town Mills Road, which is now enclosed and converted into a very pretty shrubbery to the grounds of a villa. He was unable to procure a specimen, but the rock appeared only to differ from some of that about to be described in the rather greater size of the felspar crystals.

The "spilite" is quarried in more than one part of Mont de l'Ouest, a rather conspicuous eminence overlooking the sea on the north-western side of St. Heliers. The principal pit is on the south-eastern side of the hill, close to the part which is called the People's Park. It is an oblong excavation with the longer side facing roughly east. The northern side consists of a breccia, the fragments being a purplish "spilite," rarely amygdaloidal, separated by a compact green material. This rock much resembles one of the brecciated rocks which occur at Bardon Hill. At the northern end of the western side is a solid purplish "spilite," without amygdaloids. The cliff is then cut by a dyke a few feet thick, resembling a fine-grained diorite. After it comes "spilite" containing apparently many fragments, up to about 2 inches in diameter, distinguished by a pale green speckling due to abundant epidote. This rock on the whole suggested flow-brecciation. Then follows a slightly amygdaloidal "spilite." The southern wall is formed by a purplish "spilite" with rather numerous porphyritic felspars up to about $\frac{1}{4}''$ long and amygdules. Some of the latter are approximately spherical; these also seldom exceed $\frac{1}{4}''$ in diameter. Others are elongated and irregular in outline, but they are occasionally as much as an inch long.

[1] or "Gallows Hill," as it is named on some maps.

In the field it was hardly possible to fix the precise boundaries of the above varieties of "spilite," or to determine their dip, so that the order of succession is doubtful.

Small quarries have been opened to the north of the pit just described. In most of them little could be seen, but one, some 50 yards to northward of the last-named, gave the section as figured and showed the "spilites" to be the result of contemperaneous volcanic action.



(1) "Spilite," somewhat porphyritic.
(2) "Spilite," rather amygdaloidal.
(3) Well banded green argillite and fine grit, dipping roughly at about 45° to W.S.W. and passing down into.
(4) A breccia, the fragments being a compact purplish "spilite," sometimes amygdaloidal, rarely porphyritic, the matrix rather rotten. The breccia is exposed for about five feet vertical.

A comparison of the rocks exposed in these openings made it probable that (4) is underlain by another mass of "spilite," *i.e.* that two lava flows are parted by a breccia and a little banded gritty argillite.

Slides have been examined of three typical specimens obtained from the large quarry. In all of them the most important constituent of the compact ground mass is felspar in small crystals, generally lath-shaped, with a small extinction angle, apparently oligoclase. These microliths are separated by an aggregate material which appears in some cases to result from the alteration of the augite in a microcrystalline or micro-ophitic ground-mass. In no slide can the remains of original glass be identified with certainty, but a flow structure is not infrequently exhibited by the matrix in an orientation of the felspar microliths. In one slide some of the large broad porphyritic felspars (completely replaced) have a form rather like that of orthoclase, and in another slide a few examples resemble sanidine. But in the best preserved crystals the twinning is generally on the albite plan, the form is sometimes elongate, and the extinction often is at a low angle. Thus it seems that the majority are plagioclase. Other crystals are completely replaced, generally by viridite or chlorite, but have retained a definite form and appear to represent a ferro-magnesian silicate. Iron oxide is also present sometimes in the form of ilmenite. Amygdules, especially in one rock, are fairly large and numerous. The minerals of secondary origin in the slides include viridite, a chlorite (sometimes apparently

penninite of Lévy), epidote, a carbonate (sometimes replacing felspar), azeolite, iron oxides, kaolin, and possibly augite granules.

The brecciated "spilite" from the northern side of the quarry contains angular or sub-rounded fragments with a slightly blackened or iron-stained edge. In these fragments the fresh-looking microliths of oligoclase indicate a flow structure. The intervening aggregate exhibits extremely minute crystalline specks, but, owing to the disseminated ferrite, it is difficult to decide whether this can be resolved completely into individualized minerals, or may possibly include some remains of original glass. Some of the porphyritic felspars are plagioclase; others (clearer crystals) resemble the tabular Carlsbad twins of sanidine; these sometimes form a diverging group. Rather irregular, often elongated patches of chlorite have apparently filled original vesicles microscopic in size. The matrix in which the fragments are imbedded consists of broken felspar, possibly of some quartz, and of dusty materials, probably containing minute granules of epidote or perhaps augite. This matrix, which is not very different from the ground-mass in the fragments, is somewhat banded. It is thus evident that the rock is a volcanic agglomerate.

The solid purple "spilite," from the northern end of the western face in the quarry, consists mainly of crowded felspar microliths and of interstitial material, which is either a clear viridite or a decomposed and cleaved mineral, and probably represents the pyroxene of a micro-ophitic ground-mass. Much opacite and small flakes of haematite are associated. One porphyritic crystal seems very probably to have been an augite (now largely replaced), and other more irregular patches of secondary minerals may have had a like origin. The porphyritic felspars are much decomposed. Some, however, exhibit twinning on the Carlsbad type, with which in certain cases oscillatory twinning is combined. This also occurs by itself. The usual long lath-like microliths are less frequent in the matrix of this than of other varieties, the crystallites sometimes having a rather stumpy or more irregular step-like outline.

In the amygdaloidal "spilite" from the southern face of the quarry the ground-mass was probably originally micro-crystalline; the small lath-shaped felspars are well-preserved, but the augite is replaced by granular aggregates, which sometimes occupy long prismatic spaces. Epidote is abundant in some parts, especially around the amygdules. The porphyritic felspars are large and fairly clear, but they include scattered kaolin and epidote which in some cases may result from the alteration of included magma. One crystal exhibits two arms which might belong to a Baveno grouping of a plagioclase series. The green pseudomorphs of porphyritic crystals which were probably augitic are fairly abundant. The numerous and large amygdules contain viridite, epidote (often intercrystallized with a small amount of a water-clear mineral, evidently later than the epidote and resembling quartz), calcite, or an allied carbonate. Sometimes these secondary minerals form successive zones within a vesicle; and they also occur in the ground-mass, in veins, and within porphyritic crystals.

At the base of the south face of Mont de l'Ouest, by the road to St. Aubyn, is another quarry.[1] The rock here is a compact spilite,[2] sometimes very difficult to distinguish from a flinty argillite. As it differs considerably from those already described, it may be well to add a short account of the microscopic structure.

This shows a fairly uniform ground-mass in which we cannot recognize any unaltered glass, although the chlorite and grains of iron oxide (probably in part ilmenite) which formed from the interstitial substance are very minute. The most distinct constituents are the felspar microliths which are much crowded and exhibit some approach to a fluidal arrangement. Occasional small patches where the iron oxide is in more minute and closer grains represent apparently a slight heterogeneity of the magma. With a high power the chlorite is seen to consist of very minute imperfectly rhomboidal flakes; it occurs in the ground-mass, in an occasional amygdule or crack associated with epidote, and also replacing rare microporphyritic crystals. Certain of these have the shape of augite; but two varieties may be present, since some are imperfect or skeleton forms consisting of iron oxide with viridite included. Minute well-defined crystals of a brownish mineral are possibly pyroxenic. They exhibit dichroism from brown to a very pale tint, are zoned, have a marked longitudinal cleavage, and a straight, or nearly straight, extinction.[3] The mineral may have been a hornblende, but as it occurs in short stout prisms, terminated by low-angled domes, giving transverse hexagonal sections, and contains brownish inclusions along parallel lines, hypersthene or possibly amblystegite is suggested. It is associated not infrequently with clustered granules of iron oxide or of chlorite. One crystal is long and narrow; this, however, might be a section along an edge; the dull polarization tints, and perhaps the diminished dichroism, might be the result of subsequent alteration. Except for the green pseudomorphs, which are neither large nor numerous, the rock is scarcely to be called porphyritic. It is locally cracked, indicating slight brecciation without material disturbance.

The specific gravity of the solid purple "spilite" is 2·78, that of the compact "spilite" by the athletic club building is 2·75. These results and the microscopic structures show that Prof. de Lapparent has rightly referred the rocks to the porphyrites. Probably they may be ranked with the more basic rather than with the more acid members of the group.

The "Phyllades de St. Lo" were examined at several places. So far as was seen, they are a greenish grey argillite, similar to rocks found near Granville (Normandy).[4] Two specimens obtained on the shore west of St. Aubin, not far from the boundary of the "granulite" are interesting as showing under the microscope slight contact altera-

[1] In it at the time of our visit, in 1888, stood the building of an athletic club. —T.G.B.

[2] It is cut by two or three "greenstone" dykes.

[3] It is impossible to obtain any definite results.

[4] Many of the rocks here are greenish to purplish argillites, sometimes rather flinty, which recall certain parts of the Longmynd group.

tion. Microscopically they are compact very hard argillites much jointed, with a flinty fracture. The more northern of the two masses exhibits the more distinct signs of bedding. Under the microscope the ground-mass appears dull, greenish, or greenish-brown, enclosing clearer generally crystal-shaped areas, which apparently indicate an incipient formation of andalusite. Very minute high-polarizing microliths of a fibrous character are scattered through the slide. Occasionally definite grains of quartz or felspar are preserved, which were doubtless constituents of the original sediment. In the southern specimen they are more numerous in one part, which therefore must have been very slightly coarser in texture. The two specimens do not exhibit any important differences, but in the more northern the incipient crystals perhaps contrast more sharply with the ground-mass. This consists of granules or quartz possibly felspar, with opacite, and abundant minute flakes of a brownish to a greenish mineral. The former variety (which dominates in the more northern outcrop) is almost certainly biotite; the latter (which characterizes the other rock) is more like a chlorite, but it may be only a hydrous form of the same mineral.

The "chloritoschiste" of M. Noury at Petit Part was also examined.[1] He describes it as "d'une schistosité encore marquée malgré le contact des porphyres pétrosiliceux," but this structure did not appear to Professor Bonney remarkable, so far as he saw the rock. M. Noury also speaks of it as the last member of the "terrain primitif" of the globe, so a specimen was brought away for examination. In the field it had the aspect of an ancient rather basic igneous rock. Under the microscope it exhibits idiomorphic felspars much altered, some certainly plagioclase, some perhaps more nearly resembling orthoclase, with other porphyritic crystals which are very possibly pyroxenic, and are replaced by a carbonate such as ankerite or dolomite, sometimes with associated pyrite. The matrix consists of felspar much kaolinised, of viridite, of a carbonate which may have formed as a pseudomorph in felspar, and of crowded specks of pyrite. The specific gravity is 2·74. The rock is therefore a rather basic porphyrite.

V.—Woodwardian Museum Notes.

By F. R. Cowper Reed, B.A., F.G.S.

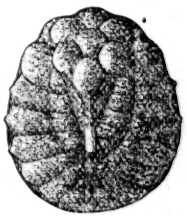
IN the Burrow Collection of fossils from the Carboniferous Limestone of the neighbourhood of Settle I have recently found a form of the genus *Cyclus* which seems to deserve notice. From a careful comparison with the figures and description of *C. Harknessi* (Woodw.) in Dr. Woodward's Monograph on Fossil Crustacea, to which we owe the greater part of our knowledge of the genus, I should consider it to be a new form allied to that species.

It may be described as follows (using Dr. Woodward's terminology): buckler oval; length $4\frac{1}{2}$ lines; breadth $3\frac{3}{4}$ lines; greatest height $2\frac{3}{4}$ lines; surface granulated. In profile the buckler appears hemi-

[1] Géologie de Jersey, pp. 53, 126.

spherical, but the posterior end is slightly more elevated and slopes more rapidly and steeply than the anterior, in this respect agreeing with *C. Harknessi*.

The raised "dorsal line" starts from the hinder border of the buckler and runs up the centre of the posterior surface as a narrow, somewhat indistinct ridge. Its upper extremity is much thickened and rises sharply into a pointed tubercular eminence forming the highest part of a crest elongated in an antero-posterior direction which rests upon and like a half ring encircles (at a distance of about two lines from the posterior margin of the buckler) the point of origin of the arms of a large fork-shaped ridge. This conspicuous ridge has the shape of a U: its arms diverging strongly at first and then becoming sub-parallel. The length of the fork is a little over one line and the tips of the arms are the same distance apart. The ridge has a rounded granulated surface, and appears to be homologous with the upper row of tubercles which are separated from the ribs by the upper furrow, as shown in Dr. Woodward's description and figure of *C. Harknessi*; and this U-shaped ridge may therefore probably be considered to be the result of the fusion of these tubercles. I term it here for convenience "the outer fork." Two faintly indicated ridges, arising from the anterior end of the tubercular eminence above described, run up the inside of the stout arms of this outer fork of fused tubercles: at their free extremities these faint ridges curve outwards so as to end in the inner and posterior pair of cervical lobes. This pair of faint ridges evidently corresponds to the Y-shaped "cervical ridge" described by Dr. Woodward in *C. Harknessi*, but will be termed here to avoid confusion the "inner fork."



Cyclus, sp. nov. ? (ex Woodwardian Museum) Carboniferous Limestone, Settle, Yorkshire. Magnified $\frac{3}{1}$ nat. size.

On the outer side of the arms of the large *outer fork* is a shallow groove almost as wide as the arms of this fork, and it is bordered on its outer side by a row of small tubercles which are more or less fused into a continuous ridge over the two anterior pairs of ribs, but are separate and distinct over the following four pairs; there is no tubercle visible over the last and 7th pair of ribs. In the figure of *C. Harknessi* all the tubercles are distinct. This broad *upper groove* would correspond with the upper furrow in *C. Harknessi*, but its greater width and more pronounced character are noticeable.

Below this row of small, partly-fused tubercles, and parallel to it, is a much shallower and narrower depression, from which the seven

pairs of ribs arise and descend the steep sides in an oblique forward direction as rounded coarsely granulated ridges, almost as far as the lower margin, before reaching which they suddenly die out, leaving a somewhat broad granulated area, which occupies the lower edge of the buckler and is bent outwards to form an encircling rim as in *C. Harknessi*. It cannot be seen in this specimen whether the rim is continued round the anterior border or not, but presumably it is so, as shown in Dr. Woodward's restoration of the profile of *C. Harknessi* (see woodcut, Brit. Foss. Crust. p. 252).[1]

The first or most anterior rib is nearly double the breadth of the other lateral ribs, and is also more protuberant. In front of the outer fork is a group of large prominences or "lobes," which cover the anterior portion of the buckler. The innermost and central "cardiac" lobe is apparently oval in shape with a longer antero-posterior diameter, and is situated on a line joining the free extremities of the arms of the outer fork.

Lying in front and outside of this lobe is a pair of smaller lobes with polygonal borders; in them the arms of the inner fork (? = "cervical ridge" of Woodward) terminate. In front of and between them is a very slightly elevated area, which hardly merits the name of "lobe," but which undoubtedly corresponds to the anterior one in the diamond-pattern of these four lobes in *C. Harknessi*.

Around this inner group are placed five more well-defined lobes; one of these is median and anterior, the other four being paired and lateral. Along the outer margin is another row of lobes, which seem not to have been so largely developed, and are not well exposed in this specimen. They probably correspond to those in a similar position in *C. Harknessi*.

It will be seen from the above description that this specimen bears a strong general resemblance to *C. Harknessi* (Woodw.), but in some details shows differences. That these, however, are not improbably due to a different stage of development of *C. Harknessi* appears likely, (1) by the possibility of deriving the "outer fork" from a fusion of the upper row of tubercles of *C. Harknessi*; (2) because the two lateral grooves cutting the upper portions of the ribs can be derived from a broadening of the furrows described in *C. Harknessi*; (3) from the tendency to fusion of the tubercles in the row separating the two furrows in this new form.

On the other hand, it may be argued that these characters are of sufficient importance to constitute varietal or even specific modifications of *C. Harknessi*. Hence the interest of this specimen. Whether it may hereafter turn out to be a new species, a variety, or to be due only to difference of age, it will be convenient to have an easy reference to this form which is certainly distinct from any yet described, and I would therefore propose for it the name of *C. Woodwardi*, after the author who has contributed most to our knowledge of these organisms.

[1] See also "Contributions to British Fossil Crustacea," in Geol. Mag. 1870, Vol. VII. pp. 554–560, Pl. XXIII.

VI.—On the Occurrence of *Ursus ferox* in the Pleistocene of Malta.

By John H. Cooke, F.G.S., etc.

THE labours of the late Admiral Spratt, R.N., and of the late Professor Leith Adams, F.R.S., in the cavern deposits of the Maltese Islands were rewarded by the finding of a unique and interesting land fauna, among which were Elephants, Hippopotami, Land-tortoises, gigantic Dormice, and aquatic Birds, the presence of which in so limited an area was incompatible with the present existing physical conditions of the Islands. While carrying on his work of investigation in a cave in the Zebbug Gorge, Uied el Kbir, in 1859, Spratt noticed that many of the remains of Elephants that were exhumed presented the appearance of having been fiercely gnawed,[1] and later on when Adams was excavating the Mnaidra gap it was observed that many of the elephantine remains were in a similar condition.

From the situations in which the remains were found, and their condition, these gentlemen inferred that carnivora had lived in the district contemporaneously with the hippopotami; but notwithstanding the most diligent research extending over a period of twenty years, the only tangible evidences in support of their inferences were these gnawed bones.[2]

During the Spring of the present year I was engaged in carrying out, with the aid of a grant from the Royal Society, some excavations in the Har Dalam cavern, a subterraneous gallery situated in a gorge of the same name in the eastern extremity of Malta, and after having excavated six large trenches and obtained some hundreds of bones of *Hippopotamus pentlandi*, *Elephas mnaidriensis*, *Cervus barbarus*, and numerous other animals, I had the satisfaction of discovering an entire ramus of the lower jaw of a Bear, with its canine and molars *in situ*, as well as five other canines belonging to other individuals of the same species.

The trench in which the jaw and teeth were found is situated on the left-hand side of the cavern, at a distance of fifty feet from the entrance. The floor was strewn to a considerable depth with large boulders, which in some places were heaped up against the sides of the cavern to a height of from two to three feet. Having cleared a space of about thirty square yards, I commenced operations on a friable marly loam, which in this part of the cavern takes the place, as the surface layer, of the red soil that is found farther within.

The first evidence of the presence of the carnivoræ was a large canine, the fang of which was unfortunately broken by a blow from the pick of one of the workmen, before the tooth was noticed. This discovery was soon followed by that of a complete ramus of the lower jaw, with its molars, and canine teeth *in situ*. The peculiar nature of the matrix in which it was embedded unfortunately pre-

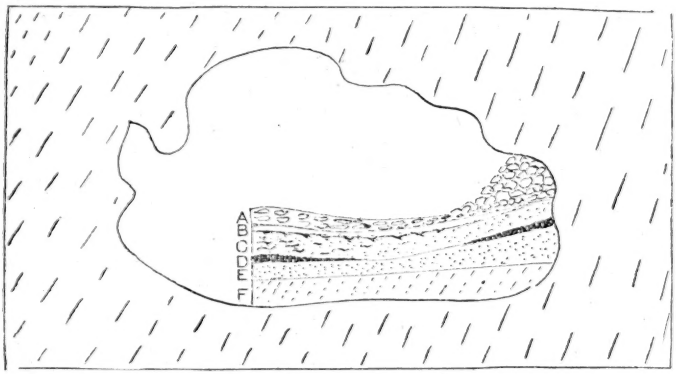
[1] Proc. Geol. Soc. vol. xxiii. p. 288.

[2] In a collection of fossils sent by Capt. Spratt to Dr. Falconer, a small canine of a carnivorous animal of the size of a fox was present.

vented me from getting it out entire. The articular processes broke off, but a few fragments were recovered and pieced together.

Four other canines were afterwards discovered, each of which was in a fairly perfect state of preservation.[1] Associated with these remains were found several vertebræ and fragments of limb-bones of hippopotamus, and vertebræ and portions of horns of stags; but none of them presented any evidences of having been gnawed.

The excavation which, when finished, measured 12 feet, by 10 feet, by 6 feet, exhibited in section the following sequence of deposits:



Section of Har Dalam Cave, at Trench No. VI., showing Succession of Deposits.

A. A layer of rounded boulders that lay scattered over the floor to a depth of two feet.

B. Cave-floor consisting of a friable marly loam, about nine inches thick, containing numerous land-shells, roots of plants, limpet shells, a shell of a *Cerithium*, and the vertebræ of a small fish. These latter had evidently been introduced.

C. A stratified layer of rounded boulders, intermixed with a grey marly loam containing an abundance of land-shells.

D. A friable marly loam with a few pebbles. Entire antlers, jaws, and limb-bones of *Cervus barbarus*, together with fragments of very old pottery, occurred in abundance.

E. A layer of indurated, light-grey loam containing a few antlers, teeth, and bones of *C. barbarus*, and a jaw and five canines of *Ursus ferox*, and remains of *H. pentlandi*.

F. A layer of about 1 foot 6 inches in thickness, similar in composition to E, but more indurated. Lying at the base of this layer, and on the original rock-floor of the cave, were numerous molars, portions of tusks, and limb-bones of Hippopotamus.

All of the layers in this section presented distinct evidences of stratification; but in the lower ones the thickness of the deposits and their comparative homogeneity contrast strongly with the numerous thin layers of which the upper beds are composed, and with the assortment of boulders, pebbles, and organic remains of which they are made up.

From the evidences thus afforded its seems that the deposits owe

[1] One of these Mr. A. S. Woodward, F.G.S., has determined as belonging to the left side of the mandible of a species of *Canis*, equalling a wolf in size.

their origin to periodical floodings of the cavern, during which the remains that lay scattered over the cavern floor, near the mouth, were washed further within and were buried in the muddy sediments of the water.

The state of mineralization in which the remains of the Hippopotamus, the Stag, and the Bear are, indicates that these animals occupied the Maltese area contemporaneously.

Further researches will, I have no doubt, lead to other discoveries, and it will therefore suffice for the present to simply place on record these, the first tangible evidences of the former occurrence of carnivora in the Maltese area.

NOTICES OF MEMOIRS.

Dr. C. I. Forsyth-Major—On the Fossil-remains from Samos.

C. I. Forsyth Major, Le gisement ossifère de Mitylini. Extrait de Samos, Etude géologique, paléontologique et botanique. Par C. De Stefani, C. I. Forsyth Major, et W. Barbey. (Lausanne, Bridel, 1892.)

SEVERAL ancient authors, as Ælianus, Heraclides, Ponticus, and others, speak of the former existence of monsters on the Isle of Samos, and mention expressly that their bones—which are claimed by Plutarch to be the remains of the Amazons slain by Bacchus—are still to be seen in the island.

This induced the author, when visiting Samos for other scientific purposes, to search for fossil bones; and he was fortunate enough to find a rich deposit of them in the vicinity of the village of Mitylini, in the eastern part of the island, imbedded in a volcanic tufa, alternating with strata of sandy marls and gravels. These same deposits had been seen and described almost fifty years ago by Admiral (then Lieutenant) Spratt, who failed, however, to discover fossils in them. The following is a complete list of the Vertebrate fauna of Samos, compared with other deposits in which a certain number of species have been found agreeing with those of Samos.

From the following comparison it may be seen, that of the 43 Mammalian species from Samos, 25 at least are represented equally at Pikermi (Greece), 13 at Maragha (Persia), 7 at Baltavar (Hungary), 7 at Mont Leberon (France), so that the contemporaneity of all these deposits, and many others less well known, is placed beyond doubt.

Whilst the majority of Palæontologists assign all these deposits to the older Pliocene, the author adduces reasons for which, in accordance with the views of Professors Boyd Dawkins, Depéret, Gaudry, and others, he holds them to be Upper Miocene. He points out that the other view is to be traced back to Dr. Theodor Fuchs, who regarded a very recent deposit of fossil shells near the sea-shore at Raphina, four miles distant from Pikermi, as contemporaneous with the Pikermi beds. If this view were correct, the Pikermi beds would have to be assigned to the uppermost Pliocene, or even to the Pleistocene, so that Dr. Theodor Fuchs must have been led into an error of observation.

List of Animal Remains from Samos showing their Occurrence also in other Localities.

	Samos.	Concud. (Spain.)	Mt. Lebéron. (France.)	Croix-Rousse. (France.)	Baltavar. (Hungary.)	Pikermi. (Greece.)	Troy. (Asia Minor.)	Maragha. (Persia.)
MAMMALIA.								
Primates.								
Fam. Cercopithecidae.								
Mesopithecus Pentelici, Wagn.	?	...	...	...	x	x	...	...
Carnivora.								
Fam. Felidae.								
Machairodus, sp.	x	...	...	...	...	...	...	...
Felis Neas, Major	x	...	...	...	...	...	...	...
Fam. Hyaenidae.								
Lycyaena Chaeretis, Hens. (Gaudr. et Lart. sp.)	x	...	...	...	...	x	...	...
Hyaena eximia, Roth et Wagn.	x	x	x	...	x	x	...	x
Fam. Viverridae.								
Ictitherium Orbignyi, Gaudr.	x	...	x	...	...	x	...	...
——— *robustum*, Gaudr. (Nordm. sp.)...	x	...	...	...	...	x	...	...
——— *hipparionum*, Gaudr. (Gerv. sp.)	x	...	x	...	...	x	...	x
Fam. Mustelidae.								
Mustela palaeattica, Weith.	x	...	...	...	...	x	...	...
Promephitis Larteti, Gaudr.	x	...	...	...	...	x	...	...
Meles maraghanus, Kittl.	x	...	...	...	...	...	...	x
Artiodactyla.								
Fam. Antilopidae.								
Palaeoryx Pallasii, Gaudr. (Wagn. sp.)	x	...	...	...	...	x	...	x
——— *rotundicornis*, Maj.	x	...	...	...	...	x	...	...
Protoryx Carolinae, Maj.	x	...	...	...	...	x	...	...
——— *longiceps*, Maj.	x	...	...	...	...	...	...	x
——— *Gaudryi*, Maj.	x	...	...	...	...	...	...	x
——— *Hippolyte*, Maj.	x	...	...	...	...	...	...	...
Helicophora rotundicornis, Weith.... ...	x	...	...	...	...	x	...	x
Gazella deperdita, Gaudr. (Gerv. sp.) ...	x	x	x	x	x	x	...	x
Gazella, sp.	x	...	...	...	...	...	...	...
Gazella ?	x	...	...	...	...	...	...	...
Prostrepsiceros Woodwardii, Maj. ...	x	...	..	...	...	...	...	...
Prostrepsiceros (?) sp.	x	...	...	...	...	...	...	x
Palaeoreas Lindermayeri, Gaudr. (Wagn. sp.)...	x	...	x	...	...	x	...	x
Tragoceros Valenciennesi, Gaudr.	x	...	...	...	...	x	...	...
——— *amalthaeus*, Gaudr. (Roth et Wagn. sp.)	x	x	x	x	x	x	x	?
Fam. Ovidae (?).								
Criotherium argalioides, Maj.	x	...	...	...	...	...	...	...
Capra ?	x	...	...	...	...	...	...	...
Fam. Giraffidae.								
Samotherium Boissieri, Maj....	x	...	...	...	...	...	...	x
Palaeotragus Rouenі, Gaudr.	x	...	...	...	...	x	...	?
Helladotherium Duvernoyi, Gaudr. ...	?	...	...	...	...	x	...	...
Fam. Cervidae.								
Dremotherium (?) *Pentelici*, Gaudr. ...	x	...	...	...	...	x	...	...
Fam. Suidae.								
Sus erymanthius, Roth et Wagn.... ...	x	...	...	...	x	x	x	x
Perissodactyla.								
Fam. Equidae.								
Hipparion mediterraneum, Hens.	x	x	x	x	x	x	x	x
——— *minus*, Pavlow	?	...	...	...	...	...	...	...

	Samos.	Concud. (Spain.)	Mt. Leberon. (France.)	Croix-Rousse. (France.)	Baltavar. (Hungary.)	Pikermi. (Greece.)	Troy. (Asia Minor.)	Maragha. (Per-sia.)
Fam. RHINOCEROTIDAE.								
Rhinoceros pachygnathus, Wagn.... ...	x	...	...	...	x	x	...	...
—— *Schleiermacheri*, Kaup.	?	...	...	x	...	x	...	...
Proboscidea.								
Fam. ELEPHANTIDAE.								
Mastodon Pentelici, Gaudr. et Lart. ...	x	...	...	...	x	x	...	x
—— *turicensis*, Schinz.	x	...	...	...	...	x	...	...
Fam. DINOTHERIIDAE.								
Dinotherium, sp.	x	...	...	...	...	...	...	...
Ancylopoda.								
Fam. CHALICOTHERIIDAE.								
Chalicotherium Pentelici, Gaudr. sp. ...	x	...	...	...	...	x	...	...
Rodentia.								
Fam. MURIDAE.								
Acanthomys Gaudryi, Dames	x	...	...	...	...	x	...	...
Chiroptera.								
Fam. ?								
Incomplete cranium of indetermined genus.	x	...	...	...	...	...	...	...
Edentata.								
Fam. ORYCTEROPODIDAE.								
Orycteropus Gaudryi, Maj.	x	...	...	...	...	...	...	...
REPTILIA.								
Testudinata.								
Fam. CHERSIDAE.								
Testudo, sp.	x	...	...	...	...	...	...	...
AVES.								
Ratitae.								
Struthio Caratheodoris, Major.	x	...	...	...	...	...	...	...
Carinatae.								
Fam. CICONIIDAE.								
Amphipelargus Majori, Lyd.	x	...	...	...	...	...	...	...
Aeis...	x	...	...	...	...	...	...	...

The almost universal view that the fauna of the Upper Siwaliks is the eastern continuance of the Pikermi fauna, must likewise be abandoned. The two have not one species in common. The former is doubtless more recent than the latter, in which the number of still living genera is much less. In the fauna of Pikermi and Samos there are wanting such living genera as *Anthropopithecus, Macacus, Semnopithecus*; *Canis, Ursus, Mellivora, Lutra*; *Elephas*; *Equus*; *Hippopotamus*; *Camelus, Tragulus*; *Rhizomys, Lepus*, characteristic of the Siwaliks on the one hand, and partly of the Upper Pliocene of Europe on the other. Neither can any of the Antelopes of Pikermi and Samos, although showing relations to living African forms, be identified with living genera (with the single exception perhaps of *Gazella brevirostris*, Gaud.), whilst among the Siwalik Antelopes we find no less than five living genera at least, viz. *Bose aphus, Hippotragus, Gazella, Tetraceros, Alcelaphus.*

Short characteristics are given of several particularly interesting members of the Samos fauna. The author adduces reasons for considering *Chalicotherium* (*Ancylotherium*) to be neither an Edentate nor a Perissodactyle, but forming a separate order.

Amongst the Ruminantia chiefly worthy of mention is a member of the Giraffidae, the *Samotherium Boissieri*, a complete skull of which has recently been added to the British Museum. The male possessed horn-cores implanted directly on the roof of the orbits; the females were hornless. A near relative of the *Samotherium* was the *Palæotragus Roueni* (Pikermi, Samos), which hitherto has been considered as an Antelope.

The *Criotherium argalioides*, chiefly represented by four nearly complete crania in the British Museum, is a most curious form of Ruminant, showing some affinities to the Antelopidæ and Ovidæ, though it cannot be assigned to either of these families. In the form of the horn-cores it resembles the *Budorcas* of Assam and Thibet.

The new genera *Protoryx* and *Prostrepsiceros* are considered to be the forerunners respectively of *Hippotragus* and *Strepsiceros*, both living African Antelopes.

A species of *Orycteropus*, the first true Edentate found fossil in the Old World, has been already recorded in this Magazine on a former occasion (See Geol. Mag. Dec. III. Vol. VI. 1889, p. 431).

Amongst the scanty Avian remains deserves mention a *Struthio*, represented by a femur and part of the pelvis, scarcely to be distinguished from the African Ostrich.

The principal collection of the Samos fossils has been presented by its owner, Mr. William Barbey, to the College Gaillard at Lausanne. A second collection, important chiefly for its complete specimens of Ruminants, is actually in the British Museum. Smaller collections of duplicates have been presented to the museums of Geneva, Lausanne, and the Pythagoras Gymnasium at Vathy (Samos). Lastly a smaller collection brought from Samos by Dr. G. von Bukowski, of the Geologische Reichsanstalt of Vienna, is deposited in the Geological and Palæontological Museums of the Vienna University.

REVIEWS.

I.—The Fossil Fishes of the British Coal Measures.

"On the Fossil Fish-remains of the Coal Measures of the British Islands. Part I. Pleuracanthidæ." By James W. Davis, F.G.S., F.L.S. Sci. Trans. Roy. Dublin Soc. [2] vol. iv. pp. 703–748, pls. lxv.–lxxiii. 1892.

THE British Coal Measures have probably yielded more remains of fishes than the corresponding horizon in any other country, and the collections of these fossils are now very extensive. At the time when Agassiz was preparing his "Poissons Fossiles," they were almost the only Upper Carboniferous fish-remains accessible to him, and they thus comprise many of the types of his species; but since those early researches, most of the publications on the

subject have been brief, scattered, and desultory, and our knowledge of the fishes of the British Coal Measures has in some respects—though not in all—lagged behind that of certain corresponding foreign strata. About fifteen years ago the Palæontographical Society published the first part of two memoirs proposing to include a large portion of the subject; but nothing further has been heard of these, and there seems to be no immediate prospect of their continuation. It is, therefore, with considerable satisfaction we are able to announce, that the Royal Dublin Society has decided to publish a series of descriptions and figures of all the more important fish-remains from the British Coal Measures that are available for the purpose. The work has been undertaken by Mr. James W. Davis, who, by his monograph of 1883, has already given a definite meaning to the long series of manuscript names applied by Agassiz to the fragmentary ichthyolites from the Lower Carboniferous, and who has himself made many contributions to our knowledge of the fish-fauna of the Carboniferous Period. The memoir will appear in annual instalments, and the first part has now reached us.

This opening part deals with the Elasmobranch family of Pleuracanthidæ, of which numerous fragmentary remains occur in all Coalfields, and of which so many tolerably complete skeletons have been discovered in Germany, Bohemia, and France. Hitherto, the British material has not been examined in detail with reference to these discoveries on the European Continent, or in comparison with certain discoveries of Pleuracanth skulls in Texas; and Mr. Davis' survey is thus in great part new, especially as regards the associated groups of teeth and remains of the endoskeletal cartilage. Nine beautiful plates, by Mr. Crowther, serve to illustrate the text, and will form a contribution to the subject of permanent value, however much future discoveries of skeletons may cause modifications in the taxonomy and interpretations adopted. One can only regret that the known British fossils should as yet remain comparatively fragmentary.

The Pleuracanthidæ are placed by Mr. Davis in the order Ichthyotomi, and the genus *Pleuracanthus* is retained in the wide sense in which he and Egerton proposed to regard it years ago. It is pointed out still more clearly than before that there exists every possible gradation between the spines named *Pleuracanthus* and those named *Orthacanthus*; and one specimen is described (p. 720, pl. lxvi.) in which it is proved that there occur in a single mouth teeth of all the three forms determined by Fritsch as characteristic of *Pleuracanthus*, *Orthacanthus*, and *Xenacanthus* respectively. It is also shown that teeth with round cusps, and others with compressed keeled cusps, occur in one and the same jaw, thus confirming an observation already made by Koken in the Permian Pleuracanths of Germany. The teeth, indeed, prove to be of little or no value for the diagnosis of species; and for the systematic arrangement of the fossils Mr. Davis relies upon the characters of the spines.

One fossil from the Yorkshire Coal Measures is interpreted as a

pectoral fin, and a few neural or hæmal arches and fin-supports are referred to; but the only skeletal elements of importance are portions of cartilage. There are some beautiful figures of the more or less fragmentary jaws; and many other pieces of calcified cartilage of varying shape are both described and figured. Mr. Davis's main contention is, that many of the cartilages show a distinct segmentation—a feature observed by Cope in the Pleuracanth skulls from Texas; and certainly, it must be admitted, some of the fossils present appearances rather suggestive in this connection. More satisfactory specimens, however, are still required before any definite result can be arrived at; and whether or not Mr. Dinning's fossil, for example (pl. lxvii. fig. 2), be the cranial roof of a Pleuracanth, the restored sketch (*ibid.* fig. 2*a*.) appears to us to be unjustifiable imagination totally at variance with the most fundamental principles of Elasmobranch anatomy. We are disposed to criticise, too, when clavicular elements are ascribed to the shoulder-girdle (p. 711); and there is a distinct contradiction in regard to shagreen, this being said to be absent in *Pleuracanthus* on p. 705, while "masses of shagreen" are described as found with remains of this genus on p. 714. Some of the species must have attained a very large size, one slab of jaws from Newsham probably indicating a fish between 3 and 4 metres in length.

The systematic portion of the work, as we have said, relates chiefly to spines, and the following species are recognized:—

Pleuracanthus lævissimus, Ag.
——— *robustus*, Davis.
——— *Wardi*, Davis.
——— *undulatus*, sp. nov.
——— *tenuis*, Davis.
——— *denticulatus*, Davis.
——— *Howsei*, sp. nov.
——— *alatus*, Davis.
——— *erectus*, Davis.
——— *horridulus*, Traquair.
——— *cylindricus* (Ag.) Davis.
——— *Thomsoni*, sp. nov.
Pleuracanthus obtusus, nom. nov. (= *Phricacanthus biserialis*, Davis).
——— *serratus*, sp. nov.
——— *Woodwardi*, sp. nov.
——— (*Lophacanthus*) *Taylori*, Stock.
——— (*Compsacanthus*) *triangularis*, Davis.
——— (*Diplodus*) *equilateralis*, Ward. [A tooth.]
Anodontacanthus acutus, Davis.
——— *obtusus*, Davis.

All these spines are described in detail, with their ascertained distribution, and each description is accompanied by one or more fine figures. The specific characters are chiefly found in the shape of the transverse section, and in the form and situation of the denticles. Only a very small amount of variation is allowed in each case, while several new forms of spine are named; and it must remain for future discoveries of complete fishes to determine how far these observed differences are of specific value. We would only remark that it is somewhat hazardous to identify two Lower Carboniferous spines (as the author does) with species characteristic of the Upper Carboniferous; and we are inclined to think that some of the differences in denticulation will prove to be due entirely to chemical erosion during fossilisation.

The fragmentary nature of the fossils described admits of so much difference of opinion in many determinations, that it scarcely seems profitable without further evidence to discuss the various points.

Mr. Davis has done good service in amassing the series of facts, which will remain long after the personal equation has vanished in fuller knowledge; and we feel that at last there is a prospect of the British Upper Carboniferous fishes being speedily described and figured as they deserve to be. A. S. W.

II.—Catalogue Illustré des Coquilles Fossiles de l'Éocène des Environs de Paris. Par M. Cossmann. Annales de la Société Royale Malacologique de Belgique. Bruxelles, 1886—1892.

THE appearance of the fifth and last fascicule of M. Cossmann's important "Catalogue" affords a convenient opportunity of reviewing the whole work. Fasciculi I. and II. are devoted to the Pelecypoda; III. and IV. to the Scaphopoda and Gasteropoda; and V. to the Pteropoda, Cephalopoda, Brachiopoda and a general supplement. The work is much more than a mere enumeration of the mollusca occurring in the Eocene beds of the Paris Basin; it contains diagnoses of the majority of the genera and species, the range in time of the latter, and new localities; whilst a large number of new genera and species are described. Each fascicule is accompanied by a number of carefully executed plates.

M. Cossmann's "Catalogue" really supplements the well-known works of M. Deshayes, and brings the whole up to date. The extent of the revision necessary to accomplish this, the critical knowledge possessed by the author in regard to living mollusca, and to bibliography, and the infinite pains he must have bestowed upon the work, cannot be fully appreciated except by those who institute careful comparisons between the old work and the new. It is not too much to say that the originality of the "Catalogue," and the systematic and convenient manner in which the author has marshalled his facts, places his work in the front rank of malacological literature. It will always form a useful book of reference to students of Tertiary mollusca. In many respects it has modified the classification of genera, and species of doubtful affinity have found convenient resting-places. Some genera which have hitherto comprised the most miscellaneous assemblage of species, have been shorn of all save those having some legitimate affinity with the generic type. These changes, together with those brought about in enforcing the rules of nomenclature, have clothed certain of the commoner forms of Eocene mollusca with strange designations. The changing of names is always to be regretted, but if consistence and uniformity in nomenclature are ever to be attained the alteration in most instances is imperative; but in the case of the Catalogue before us the alterations of generic denominations, frequent as they are, are due to the careful zoological revision to which the species have been subjected, rather than to mere caprice on the author's part, in his interpretation of the so-called "laws of nomenclature."

In view of the opinions held by an influential section of continental malacologists, we can hardly blame the author for adopting "pre-Linnean" names, though from an English standpoint this proceeding

is a reprehensible one; it is satisfactory, however, to note that the changes due to this are exceedingly few and comparatively unimportant in the work under review. The greater number of genera have been divided into sections, or sub-genera. The value of such a classification is very manifest to workers in those groups containing large numbers of species, and is certainly a more convenient method than by elevating the sub-genera into genera, whereby the original generic name is not infrequently lost sight of.

In fascicule I. we note that a new genus *Fabagella* is proposed for the original *Corbula faba* of Deshayes, who in his "Supplement" had referred it to the genus *Poromya*, which M. Cossmann states is not found in the Paris Basin. He elevates *Arcopagia*, which is considered by many authors to be merely a sub-genus of *Tellina*, into a genus, principally because of the special characters exhibited by the sinus and general shape of the shell. *Venus conformis*, Desh., forms the type of the new genus *Atopodonta*, being separated from *Venus* properly so-called, on account of the particular disposition of the hinge, and absence of a sinus. Following other authors, M. Cossmann substitutes the name *Meretrix* for *Cytherea* by reason of the priority of the former; similarly, *Sphærium* takes the place of *Cyclas*; and *Trapezium* that of *Cypricardia*. Of all the species of *Cardium* found in the Paris Basin, only one, *Cardium Bazini*, is referred to the typical form of the genus.

Fascicule II. continues the description of the Pelecypoda. We notice that *Fimbria* is replaced by *Corbis*, the former designation having been used by Bohadsch in 1761 for a nudibranch, but as the date mentioned is prior to the appearance of the 12th edition of the "Systema Naturæ," we should prefer to retain *Fimbria* of Mégerle, and cite *Corbis* in the synonymy. *Cyclas*, Klein, 1753 (Stoliczka, 1870), is retained by M. Cossmann as a section of *Lucina*, but, as we have seen, the name *Cyclas*, Brug. 1792 (used for a very different Pelecypod) falls in synonymy under *Sphærium*; the genus having been used by Bruguière and others. Stoliczka was not justified, from our point of view, in bringing on the *Cyclas* of Klein, and we are disposed to adopt *Divaricella*, proposed by von Martens in 1880 for this genus. The resuscitation of pre-Linnean authors' works also leads our author to displace the well-known *Lima*, Brug., by *Radula*, Rhumphius, 1711; Klein, 1753. J. Sowerby's *Axinus*, 1821, is adopted, but the name having been used by Kirby in 1817 it cannot be retained, and moreover is synonymous with *Thyasira*, Leach (*fide*, Lam. 1818); in case the last-mentioned should be considered as identical with *Thyatira*, Hübner, 1816 (as by M. Cossmann), *Axinus* should apparently be replaced by *Cryptodon*, Turton, 1822, or by (?) *Ptychina*, Phil., 1836. Our author does not accept Monterosato's genus *Neolepton*, 1884, but includes it in *Lepton*; he does not agree that the oblique shells striated concentrically, on which the former genus was founded, can be generically differentiated from *Lepton*. The diagnosis of *Erycina* is amended in accordance with the typical species; this had been rendered necessary on the removal of certain forms which were shown not to belong to the genus.

The diagnosis now established is based upon *E. pellucida* and its allies; in thus limiting the characters of the genus, it becomes evident that *Erycina* does not exist in modern seas; the so-called *E. Geoffroyi*, living in the Mediterranean, is in reality a *Kellyia*. *Venericardia* is regarded as a section of *Cardita*, but it is impossible in the present state of our knowledge to distinguish one from the other; the hinge in both varies by the inclination of the teeth, following the elongation of the shell, and we have yet to learn that this was accompanied by any material modification in the structure of the animal. The author agrees with the alteration of *Pectunculus* into *Axinæa*; but for some unexplained reason the former name is retained in his subsequent work, "Révision sommaire de la faune du Terrain Oligocene Marin aux Environs d'Étampes," 1891, p. 40. By the adoption of Fischer's views in regard to *Pecten*, that genus is said not to occur in the Paris Basin, the majority of the species hitherto included therein being now termed *Chlamys*.

Fascicule III. devoted to the Scaphopoda, and the non-pulmonate holostome Gasteropoda is prefaced by a few remarks on the classification and method of description adopted in the work. The author, like his *confrères*, in illustrating the Gasteropoda, prefers to draw them upside down (*i.e.* with the mouth directed upwards and apex downwards), as he believes this position places the more interesting phenomena, from a generic point of view, in clearer light. In regard to the description of the ornamentation of the whorls of the shell, he truly remarks that the terms "transverse" and "longitudinal" are often misapplied and mistaken one for the other; he therefore proposes to use the term "axial" for all ornamentation parallel (or nearly so) to the direction of the axis, *i.e.* that usually formed along the lines of growth of the shell; and the word "spiral" for all ornament parallel to the line of superposition of the whorls of the spire. Special reservations are, of course, made for such genera as *Patella*, *Fissurella*, and *Hipponyx*.

The interesting genus *Pleurotomaria* is represented in the Paris Basin by one species, *P. concava*, Desh., but it is rare. The name *Calliomphalus* is proposed for those species having close affinity with the so-called *Turbo squamulosus* of Lamarck. The classification adopted for the Trochidæ is similar to that of Dr. Fischer; and Watson's genus *Basilissa* is represented by five species. The Scalidæ are arranged mainly on the lines proposed by M. de Boury, but the non-publication by that authority on this family, of figures illustrating several of his MSS. species, has led M. Cossmann to supply the want, and to give a particularly useful illustrated account of the whole. He proposes a new genus, *Canaliscala*, which is characterized by the possession of a short canal, and of which *Scalaria heteromorpha* of Deshayes is the type. The author does not replace *Paludina* by *Vivipara*, though he cites the latter in synonymy.

Fascicule IV. is devoted to the siphonostome and pulmonate Gasteropoda, and there can be no question that the author's study of this section—especially the first division—has been very thorough. The Cerithidæ of the Paris Basin were in a state of chaos before

the publication of M. Cossmann's "Catalogue"; in round numbers 250 species occur which had to be worked out and placed in their proper genera in this family, and it was found desirable to propose several new genera and sub-genera in accomplishing the work. The author must have considerable courage in attempting to distinguish *Potamides* from *Cerithium* in the fossil state, and the division is necessarily an arbitrary one. In regard to *Lovenella*, Sars, 1878, the author remarks that Monterosato has said that the name is pre-occupied, but this is disregarded on the grounds that the latter did not give either author or date of pre-occupation. We may therefore recall the fact that Hincks, in 1868, had used the term *Lovenella* for a Cœlenterate (Hist. British Hyd. Zoophytes, 1868, vol. i. p. 177), as Mr. R. B. Newton has pointed out. The last-mentioned author replaces the molluscan genus *Lovenella* by *Cerithiella*, Verrill, 1882, which M. Cossmann considers, from etymological grounds, is pre-occupied by *Ceritella*, Morris and Lycett, which term, however, we think is sufficiently distinctive. In consequence of our author adopting pre-Linnean works, the well-known *Rostellaria*, Lam., 1799, is replaced by *Gladius*, Klein, 1753. Amongst the Fasciolariidæ we find a new genus, *Streptochetus*, proposed for several species having considerable affinities with *Latirus*; M. Bayle, in classifying the collection in the École des Mines, Paris, believed that these peculiar forms should be included in a new genus, *Kelletia*, of which *Fusus Kelleti*, Forbes, is the type, and which Dr. Fischer considers is a sub-genus of *Siphonalia*. M. Cossmann, however, shows that the Paris Tertiary species differ from the type of *Kelletia*, and they cannot be included under *Siphonalia* on account, amongst other things, of the characters of their embryo, by the length and twisting of their canal, and by their columella, which is sometimes plicated. In spite of the exhaustive work of M. Jousseaume on *Cancellaria*, our author is able to add two new sub-genera thereto. The Conidæ have been the subject of considerable revision, and M. Cossmann's original work amongst *Pleurotoma* might fittingly be paralleled with that of Bellardi on the same genus. The Order Nucleobranchiata is represented in the Paris area by one species only—the ancient *Cyclostoma spiruloides* of Lamarck, which forms the type of a new genus *Eoatlanta*. Amongst the Pulmonata may be mentioned the new genus *Acroria*, which is placed doubtfully in the Gadiniidæ, and four new subdivisions, two of which are sections of the already overburdened *Helix*.

Fascicule V. shows that only two genera of Pteropoda are present in the Paris Basin Eocene—*Spirialis* and *Valvatina*. The *Vaginella Parisiensis* of Watelet, said to have come from the Sables de Cuise, at Mercin, is eliminated, as M. Cossmann believes that it is really a *V. depressa* from the Bordeaux district, with which we entirely concur. *Euchilotheca succincta*, Defrance, is mentioned by some as a Pteropod, but our author has placed it amongst the Cæcidæ. The Cephalopoda are represented by the genera *Sepia*, *Belosepia*, *Beloptera*, *Nautilus*, and *Aturia*; whilst five genera of Brachiopoda occur, viz.: *Crania*, *Terebratulina*, *Terebratula*, *Kingena*, and *Cistella*.

In the Supplement, which is a lengthy one, the author describes several new species, and adds some new localities. The Catalogue was such a long time passing through the Press that many alterations in nomenclature were in the meanwhile proposed. A large number of these were made by Messrs. Harris and Burrows in their work on the "Eocene and Oligocene Beds of the Paris Basin" (Geol. Assoc. separate publication) 1891; and by Mr. R. B. Newton in his "Systematic List of the F. E. Edwards' Collection," etc. (British Museum, Nat. Hist.) 1891, and are duly acknowledged by the author of the work under review.

The following abridged Table may be useful as giving some idea of the number and distribution of the species found in the Paris Basin Eocene:—

	Number of Species Catalogued.	Stratigraphical Distribution.				Paris Basin. Species occurring in	
		Lowest Eocene.	Lower Eocene.	Mid. Eocene.	Upper Eocene.	Belgium.	England.
Pelecypoda.	1075	161	295	529	388	136	144
Gasteropoda.	2080	291	487	1104	737	96	207
Pteropoda.	4	—	1	3	—	—	—
Cephalopoda.	14	1	5	10	2	6	7
Brachiopoda.	20	1	—	18	1	2	—
Totals.	3193	454	788	1664	1128	240	358

Upper Eocene includes the "Sables Moyens," and the Saint-Ouen limestone.

Middle Eocene refers to the three horizons of the Calcaire Grossier.

Lower Eocene applies to the sands of Aizy and Cuise.

Lowest Eocene comprises the "Sables de Bracheux," Rilly limestone and Lignites.

The number of species said to be common to the Paris and English beds will doubtless be materially augmented when the mollusca from the latter have been more fully described.

The "Supplement" concludes with an exhaustive index of genera, sections and species.

Reviewing the whole work, we think that the author has had a tendency to create rather too many sections in certain genera. We have heard influential French palæontologists make disparaging remarks anent the large number of species described by Bellardi, many of which are so closely allied as to be frequently indistinguishable from each other; in other words, they accused the lamented Italian malacologist of being a "hair-splitter." So far as *Nassa*, and a few other genera are concerned, we entirely agree with them, and the method at present being resorted to by Bellardi's successor, of making innumerable "vars.," is certainly to be deplored. But those "who live in glass houses should not throw stones," and our French contemporaries would do well to revise the large number of so-called species included in the Naticidæ, Cerithidæ, and Turritellidæ of the

Paris Basin in such a manner that with the type specimens, or good figures and descriptions before us, we should stand a reasonable chance of correctly determining a species.

The Royal Malacological Society of Belgium is to be congratulated on publishing such an extensive and important work; it will not be out of place, however, to mention that the author has been put to considerable expense in the matter, and the "Catalogue" is now sold in separate form.

The value of M. Cossmann's book lies in the critical manner in which he has dealt with the more or less fragmentary work of his predecessors, and in the careful and erudite manner in which he has modernized his subject. That some alterations will become necessary in overhauling new material is only to be expected, and new species will, in course of time, be added to the fauna, whilst the systematic positions of certain genera and species are yet capable of revision. As the author truly says, "L'histoire paléontologique d'une région est, en effet, comme un livre toujours ouvert, sur les pages duquel on ne peut jamais inscrire le mot *fin*." G. F. H.

III.—A Monograph of the Carboniferous and Permo-Carboniferous Invertebrata of New South Wales. Part II. Echinodermata, Annelida and Crustacea. By R. Etheridge, junior. Mem. Geol. Survey New South Wales, Palæontology No. 5. Sydney, 1892. 4to. pp. i.–ix. and 65–132. Plates xii.–xxii.

THE earlier finds in the Carboniferous rocks of Australia appeared to show the existence of a fauna very different from that co-existing in Europe. De Koninck, in his "Récherches sur les fossiles paléoziques de la Nouvelle Galles du Sud," combated that view, and went a little too far in assuming specific identity between Australian forms and similar ones either in Europe or North America. The general facies is indeed much the same, but the more accurate researches now being carried out by the accomplished author of the work before us show a parallelism rather than an identity of development. One fact, however, on which De Koninck laid stress, is still prominent, and that is the large size of many of these Australian forms as compared with that of their allies in other parts of the world: the star-fish and sea-urchins, now first made known to us from Australia, are indeed prize specimens; among the crinoids, the genera *Tribrachiocrinus* and *Phialocrinus* are no less remarkable for magnitude than for structural peculiarities; while a pygidium, on which the new species *Phillipsia grandis* is founded, "must represent a Trilobite nearly three inches in length, an exceedingly large size for a Carboniferous form." It is to be regretted that the conditions of sea-bottom that permitted such magnificent growth were not equally successful in the preservation of the fossils, which are for the most part nothing but the impressions and cavities left after the disappearance of all calcareous matter, a state in which accurate study is extremely difficult.

Of the animal-groups treated of in the present section of the Monograph, the most interesting are the Echinodermata. The

species are few. Echinoidea being represented by two, Asteroidea by three, and Crinoidea by at most fifteen; while individuals are also rare, with the unprofitable exception of crinoid stem-ossicles, which, here as elsewhere, form large beds of Entrochal Marble.

The chief Echinoid specimen has been much damaged by fire, but enough remains to show a feature of some interest. "The rows of plates in each inter-ambulacral area are certainly four, but in the middle line of the three best preserved areas, between the two contiguous rows of tubercle-bearing plates, are smaller pieces devoid of tubercles." This species seems to connect *Archæocidaris*, which it otherwise resembles, with those allied genera that have more than four rows of interambulacrals: and when better specimens are known, it will probably form the type of a new genus. At present it is called *Archæocidaris*? *Selwyni*. This and an undetermined species of *Archæocidaris* come from the Upper Marine Series of the Permo-Carboniferous.

Australian starfish of the periods in question were formerly represented only by *Palæaster Clarkei*, De Kon. To this are now added two new species, *P. Stutchburii* and *P. giganteus*. In all these species, nearly the whole of the actinal surface of each ray is taken up by the ambulacral and ad-ambulacral plates, while the marginal plates are small and sub-dorsal, not actinal as in the true *Palæaster*. Mr. Etheridge, therefore, distinguishes these species by the new sub-generic name of *Monaster*. Palæozoic starfish are, however, in such a state of confusion that he would be bold who should predict whether or no this name will meet with final acceptance. These Asteroidea all occur in the Lower Marine Series, and *P. Clarkei* also in the Upper Marine Series, of the Permo-Carboniferous.

Among the Crinoidea are recorded numerous very doubtful fragments, such as plates of a species referred by De Koninck to *Actinocrinus polydactylus*, which are probably nothing of the kind; an internal cast supposed by Mr. Etheridge to belong to *Periechocrinus*, and actually named *P. indicator* as denoting the presence of that genus in Australia, a name which we cannot help thinking will turn out to be of the *lucus a non lucendo* type; some plates doubtfully referred to *Platycrinus*; some plates provisionally referred by De Koninck to *Poteriocrinus tenuis*, Miller, and *Poteriocrinus radiatus*, Austin, species which have since been relegated to *Scytalecrinus* and *Parisocrinus* respectively, and cannot, therefore, indicate the presence of *Poteriocrinus* as Mr. Etheridge seems to think; and finally several stem-fragments, which the author is kind enough to leave unnamed.

Mr. Etheridge has met with no specimen of the interesting *Symbathocrinus ogivalis* described by De Koninck, nor is any other instance of the genus recorded from Australia. We may, therefore, take this opportunity of mentioning that the dorsal cup of an allied species, from the Irwin River, W. Australia, has been sent home by Mr. H. P. Woodward, and will, it is hoped, be described in this MAGAZINE.

Some plates referred to *Platycrinus* are said to be "ornamented

with radiating lines of very peculiar wart-like tubercles, concave at their apices." It seems to us very probable that these tubercles once bore spines like those of *Hystricrinus*, which is a Devonian form closely allied to *Platycrinus*, occurring in North America.

The remarkable genus *Tribrachiocrinus* is described afresh from the evidence of four species, of which two—*T. ornatus* and *T. granulatus*—are new. The dorsal cup in this genus is composed of three circlets of plates, viz., infrabasals, which are three, owing to the fusion of two pair; five basals, of large size and irregular shape; and five radials. In the posterior interradius are three plates, namely, the radianal, the anal *x*, and a plate between *x* and the right posterior radial resting on the radianal. Thus far the crinoid closely resembles *Eupachycrinus* and *Cromyocrinus* from the Carboniferous of America and Europe; but, turning to the arms, we find great peculiarities. In the anterior and in the left and right posterior rays, the radial has a wide articular facet (as in the genera just mentioned), on which works a wide brachial, usually narrowing above; this appears to have been followed in *T. ornatus*, which alone presents traces of arm-branches, by three more primary brachials the last of which supports two arm-branches; whether these latter branched again is uncertain. The left and right anterior radials, however, had no wide articular facet, but seem to have become fused with one or more of the primary brachials, and to have borne no regular arms. This view, to which Mr. Etheridge gives his support, resembles that of the earlier writers in that it ascribes only three main arms to the genus, and differs from that of Wachsmuth and Springer (which is misrepresented by Mr. Etheridge). To such a view there is no *a priori* objection, for much the same state of things is found in *Bærocrinus Ungerni*; at the same time it is hard to reconcile it with the figure of *T. ornatus* (plate xix.), which appears to show not six but at least ten series of distichals.

With reference to the tegminal plates of *T. corrugatus*, which Ratte described as vault-plates, but which Wachsmuth and Springer believed to be part of the disk, both parties were correct; for there is no difference between vault and disk.

As to the systematic position of *Tribrachiocrinus*, it may be pointed out that the Poteriocrinidæ of Wachsmuth and Springer included genera which, though they had arrived at a similar stage of evolution as regarded the anal area, seemed nevertheless to have sprung from two distinct stocks, one characterized by repeatedly dichotomous arms, as in *Poteriocrinus*, the other with arms in two main branches only, as in *Decadocrinus*. To these latter genera the name Decadocrinidæ has been applied, and among them there is at present reason to suppose that we must reckon *Eupachycrinus*, *Cromyocrinus* and *Agassizocrinus*, three forms that agree in the possession of a globose dorsal cup, large basals, a large radianal and a wide articular facet to the radial, characters, which, as we have seen, are also conspicuous in the cup of *Tribrachiocrinus* but not in that of *Poteriocrinus*. We regret therefore that Mr. Etheridge should prefer to retain the two latter genera in close association.

Phialocrinus is a name which Mr. Etheridge revives for the *Cyathocrinus Koninckí* of De Koninck and three new species, *P. princeps*, *P. nodosus*, and *P. Stephensi*. The genus *Phialocrinus*, as Mr. Etheridge understands it, has a cup composed of five infrabasals, five basals, and five radials, with a pentagonal axal *x* truncating the posterior basal, in a line with the radials, and supporting two plates of the anal tube; its radials have a wide facet supporting two or three wide primary brachials, which bear in each ray two main arms. It is, however, advisable to point out that the arms, beyond the earlier distichals, are unknown in all the Australian species, and that the anal area also is unknown in *P. princeps*; it is therefore doubtful how far they agree with *P. patens*, Trd., which is taken as type of the genus. They certainly do not agree with *Scaphiocrinus simplex*, Hall, with which they are supposed to be congeneric. The whole question, however, involving as it does difficult points both of nomenclature and taxonomy, cannot be discussed in a review, and since we purpose describing a specimen allied to *P. Koninckí*, we gladly defer till that occasion discussion of these and other interesting matters alluded to in the present Monograph.

Among Annelida there is only described one specimen, namely, a *Serpula*, to which is regrettably assigned a new name, apparently because it "is the first yet noted from the Permo-Carboniferous Series of New South Wales."

Turning to Ostracoda we find a rather doubtful new species described as *Carbonia australis*, and the description of *Entomis Jonesi*, De Kon. corrected; while the little bodies referred by De Koninck to *Polycope* are now supposed to be the fry of a species of *Aphania* or *Aviculopecten*.

The Trilobites of New South Wales do not extend above the Carboniferous. *Griffithides dubius*, Eth., senior, is now redescribed from older and better examples, and referred to *Phillipsia*; its axis has a peculiarly angular arch. There are also described *P. grandis*, n. sp., and some undeterminable fragments of both *Phillipsia* and *Griffithides*.

The difficulties of preparing such a book as this Monograph in a go-ahead country, far from libraries and fellow-workers, can hardly be appreciated by European students. Future parts would be improved if the author could dispense with a few misprints, such as "analagous," with the evidences of haste that occur in his quotations, and with such remarkable sentences as the following: "Waagen has described a species as *C. goliathus*, which, from his remarks, in comparing his detached plates with *P. Koninckí*, certainly appear to place *C. goliathus* in congeneric relation with the Australian Crinoid." It is much to be regretted that all the plate-figures are reversed; on plate xvi. numbers 2 and 3 are interchanged, while we have wasted many weary minutes in discovering the orientation of figures 5 to 9. Having eased our feelings with regard to these easily avoidable defects, we may conclude by offering to Mr. Etheridge our thanks for, and felicitations on, the success that he has attained.

F. A. Bather.

REPORTS AND PROCEEDINGS.

Geological Society of London.

I.—December 21st, 1892.—Prof. J. W. Judd, F.R.S., Vice-President, in the Chair.

The Chairman gave expression to the Society's deep sense of the loss which it had just sustained by the death of so distinguished a Fellow as Sir Richard Owen, who had been associated with the Society for no less than fifty-five years. He further announced that the Council, in causing a resolution of condolence to be forwarded to the bereaved family, had deputed Dr. Hicks and himself to represent the Society at Sir Richard's funeral.

In explanation of certain specimens of fossils exhibited by J. V. Parkes, Esq., F.G.S., and found in limestones about 11 miles north of Beltana Township, South Australia, Dr. G. J. Hinde said that the limestone slabs forwarded by Mr. Parkes were filled with the peculiar fossils belonging to the family Archæocyathinæ, which had been considered as probably allied to Perforate Corals. These fossils were widely distributed in rocks of Cambrian age in various parts of the world, having been found in Nevada, Labrador, Spain, and Sardinia, and they had lately been recognized in the same district in South Australia as that when Mr. Parkes specimens had been obtained, and an excellent description and figures of them were given by Mr. R. Etheridge, jun., in the "Transactions of the Royal Society of South Australia," 1890, pp. 10-23, pls. ii. iii.

The following communications were read :—

1. "On a Sauropodous Dinosaurian Vertebra from the Wealden of Hastings." By R. Lydekker, Esq., B.A., F.G.S.

In addition to *Hoplosaurus armatus* and *Pelerosaurus Conybearei*, there is evidence of another large Sauropodous Dinosaur in the Wealden, now known as *Morosaurus brevis*. Up to the present time it has been impossible adequately to compare *Hoplosaurus armatus* with *Morosaurus brevis*; but recently Mr. Rufford has sent to the British Museum an imperfect dorsal vertebra of a large Sauropodous Dinosaur from the Wealden of Hastings, which enabled the required comparison to be made. The Author describes the vertebra, contrasts it with that of *Hoplosaurus armatus*, and gives presumptive evidence that it should be referred to the so-called *Morosaurus Becklesi* (Marsh), which apparently cannot be separated from *M.* (*Cetiosaurus*) *brevis*. He has not been able to compare Mr. Rufford's specimen with the dorsals of the American *Morosaurus*, in order to discover whether the English Dinosaur is correctly referred to that genus.

2. "On some additional Remains of Cestraciont and other Fishes in the Green Gritty Marls, immediately overlying the Red Marls of the Upper Keuper in Warwickshire." By the Rev. P. B. Brodie, M.A., F.G.S.

The vertebrate remains occur in a very thin band of marly friable sandstone lying between two beds of green marl, though in some places the same bed has itself no admixture of sandy material.

Bones and teeth are so numerous that it might almost be called a bone-bed. It does not exceed three inches in thickness. It contains ichthyodorulites of Cestracion fishes, abundant palatal teeth of *Acrodus keuperinus*, ganoid fish-scales, and abundant broken bones, some of which may belong to fishes, others to labyrinthodonts, and amongst the latter a fragment of a cranial bone.

3. "*Calamostachys Binneyana*, Schimp." By Thomas Hick, Esq., B.A., B.Sc. Communicated by J. W. Davis, Esq., F.G.S., F.L.S.

A number of preparations lately placed in the hands of the Author by Mr. W. Cash, of Halifax, give much additional information on many important points of detail connected with the structure and characters of the sporiferous spike known as *Calamostachys Binneyana*, and also throw considerable light on the question of its affinities. The Author fully describes the structure of the fossil, and discusses its systematic position. His description shows the close resemblance between the structure of this spike and that of *Equisetum*; and it is noted that Carruthers, in 1867, did not hesitate to describe *Calamostachys Binneyana* as the fruit of *Calamites*, and that Binney, when making it the fruit of *Calamodendron commune*, was in practical agreement with Carruthers. Williamson, however, realizing the difficulty of reconciling the supposed vascular central part of the axis of the spike with a Calamitean affinity, suggested that the relationship lies rather with the Lycopodiaceæ. Now the establishment in the present paper of the existence of parenchymatous pith in the axis of the spike removes the chief ground for Williamson's suggestion; and the demonstration of the existence of primary vascular bundles with carinal canals affords positive proof of the closeness of its relationship with the Calamitæ. The Author gives reasons for concluding that there is much probability that the fossil described in the paper is a spike of a *Calamites* of the type of *Arthropitys*.

4. "Notes on some Pennsylvanian Calamites." By W. S. Gresley, Esq., F.G.S.

The Author believes that a group of specimens from the Pottsville conglomerate series demonstrates that the so-called Calamite-casts in sandstone are not always to be regarded as casts of pith-cavity only, but are often casts of the vascular cylinder as well; also that these specimens show that some Calamites, at all events, possessed furrowed exteriors or barks. A specimen from the Pittston bed of anthracite in the Wyoming basin also seems to suggest that the true bark had not always a smooth exterior.

A specimen from the same geological horizon as the last specimen, and from a neighbouring locality, indicates a Calamite of gigantic proportions. Another specimen, from the Pittsburgh bed, is remarkable as showing two branch-scars not on, but below the nodes of the Calamite.

5. "Scandinavian Boulders at Cromer." By Herr Victor Madsen, of the Danish Geological Survey. Communicated by J. W. Hulke, Esq., F.R.S., For.Sec.G.S.

During a visit to Cromer in 1891 the Author devoted much

attention to a search for Scandinavian boulders, and obtained three specimens; one (a violet felspar-porphyry) was from the shore, and the other two were from the collection of Mr. Savin. The first was considered to come from S.E. Norway, and indeed Mr. K. O. Björlykke, to whom it was submitted, refers it to the environs of Christiana.

The Author considered that the two specimens presented to him by Mr. Savin, who had taken them out of Boulder Clay between Cromer and Overstrand, were from Dalecarlia; and these were submitted to Mr. E. Svedmark, who compared one of them (a brown felspar-hornblende-porphyry) with the Grönklitt porphyry in the parish of Orsa, and declared that the other (a blackish felsite-porphyry) might also be from Dalecarlia.

II.—January 11th, 1893.—W. H. Hudleston, Esq., M.A., F.R.S., President, in the Chair.—The following communications were read:

1. "Variolite of the Lleyn, and associated Volcanic Rocks." By Catherine A. Raisin, B.Sc. Communicated by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., V.P.G.S.

The district in which these rocks occur is the south-western part of the Lleyn peninsula, marked on the Geological Survey map as 'metamorphosed Cambrian.'

Some of the holocrystalline rocks are probably later intrusions. The igneous rocks, which are described in detail in the present paper, belong to the class of rather basic andesites or not very basic basalts; they show two extreme types, which were probably formed by differentiation from an originally homogeneous magma. Corresponding to the two types of rock are two forms of variolite. These are fully described, and their mode of development is discussed.

The variolites occur near Aberdaron and at places along the coast. Their spherulitic structure often is developed towards the exterior of contraction-spheroids, and in this and in other particulars they correspond with those of the Fichtelgebirge and of the Durance. The volcanic rocks include lava-flows and fragmental masses, both fine ash and coarse agglomerate. They are associated with limestones, quartzose, and other rocks, which are possibly sedimentary, but which give no trustworthy evidence of the age of the variolites.

2. "On the Petrography of the Island of Capraja." By Hamilton Emmons, Esq. Communicated by Sir Archibald Geikie, LL.D., D.Sc., For.Sec.R.S.

The rocks of Capraja consist generally of andesitic outflows resting on andesitic breccias and conglomerates. The southern end seems to have formed a distinct centre of volcanic activity, whose products are younger in age and more basic in character than the rocks of the rest of the island, and may be termed 'anamesites.' The lavas appear to have flowed from a vent at some distance from the cone which probably occurred here and gave out highly scoriaceous fragments. In the other parts of the island andesite is almost everywhere formed, with patches of the underlying breccias here

and there in the valley bottoms. The chief centre of activity probably lay west of the centre of the island.

Petrographical details of the andesites and anamesites, descriptions of groundmass and included minerals of each, and chemical analyses are given. As regards the age of the constituents, the Author arranges them in the following order, commencing with the oldest:—magnetite, olivine, augite, mica, felspar, nepheline.

CORRESPONDENCE.

THE ST. BEES SANDSTONE.

Sir,—In the short notice in the last number of the Geological Magazine, of Mr. Goodchild's paper on the above, read before the British Association at Edinburgh, I read that he considers the St. Bees Sandstone equivalent to the Bunter. I entirely disagree with him in this view. It is well known to those who are conversant with the Bunter Sandstone formation that it consists of the Upper Soft Red and Mottled Sandstone. The Pebble and Conglomerate beds and the Lower Soft Red and Mottled Sandstone, only the two lower divisions occurring in the North of England. These are well marked divisions, with beds totally unlike the St. Bees Sandstone.

I believe it to be much more probable that the St. Bees Sandstone is a large development of the Red Marls, Sandstones, and Gypsum beds that lie between the Upper and Lower Magnesian Limestone in Nottinghamshire and Yorkshire, and known as the "Permian Middle Marls and Sandstones." There is a break between these Sandstones and Marls and the Lower Magnesian Limestone quite as large as between the St. Bees Sandstone and the Magnesian Limestone and Penrith Sandstone. But breaks between two formations are often only local, caused by thinning away of beds, and there is really no great unconformity between the Bunter Sandstone and the Magnesian Limestone series (now called Permian) of Yorkshire, and I should not be surprised that in some locality it was found that the one passed up into the other. I will not quarrel with Mr. Goodchild for calling these lower formations "Lower New Red Sandstone" (the old term) though I do not like it, for in Yorkshire these beds are chiefly limestone, but I must protest against the St. Bees Sandstone being called Bunter, a formation, I consider, on a higher horizon.

W. Talbot Aveline.

Oatlands, Wrington, Somerset,
December 5th, 1892.

ON THE SUPPOSED CONFLICT BETWEEN GEOLOGY AND PHYSICS.

Sir,—The late Dr. James Croll, while contending that there was ample proof from geology that conditions suitable for life on the Earth must have existed "far more than twice 20 millions of years ago"[1] (the narrow time limit of 20 million years only being supported by some physicists):—nevertheless Dr. Croll could not solve the following difficulty.

[1] Dr. Croll's paper in the Quarterly Journal of Science, July, 1877, p. 317.

If the earth (completely crusted over) have existed "far more than twice 20 million years," *à fortiori* then must the sun have been present longer than this period; for it is obvious that a habitable globe could not survive without the sun. But it is certain that if the sun have endured anything like this time, the contained store of heat must have been such—as Dr. Croll points out—that the solar nebula at that primitive age "would have extended beyond our Earth's present orbit, and of course our Earth could not at that time have existed as a separate planet" (Dr. Croll's paper in the Philosophical Magazine, May, 1868, p. 372). To infer the degree of expansion of the sun at that remote epoch, we have merely to deduce (an easy process) what the sun's temperature then was at his present rate of cooling.

Dr. Croll does not attempt to solve the difficulty he lays stress on; but is it not obvious, in view especially of the recent ideas as to space being[1] comparable somewhat to a "meteoric *plenum*," not to mention the continued other friction opposed to the flying globe—that the Earth's present orbit could not have been its original orbit? But the Earth must have come in an enormous distance towards the sun in over twice 20 million years, which is the lowest limit for the period which geology demands for the Earth's past existence, according to the evidence afforded by the known rate of deposition of sedimentary strata, etc. This kind of evidence is not vague, but mathematically convincing. Dr. Croll remarks, viz. "We have not sufficient data to determine how many years have elapsed since life began on the globe, for we do not know the total amount of rock removed by denudation; but we have data perfectly sufficient to show that it began far more than twice 20 million years ago" (Quarterly Journal of Science, July, 1877, p. 317).

So then we have the apparent fitness that then the sun was hotter than at present, the planets were further off. As the sun cools down, the planets approach him, this fact equalizing the conditions for life on the Earth over a far longer time-epoch than would otherwise be possible. This consideration affords apparently plenty of margin for past geological time, without coming into any conflict with physics.

The idea of a 20 million years' margin for the age of the sun's heat, enunciated by Lord Kelvin, depends on the assumption (in aspect arbitrary?) that the sun was formed by the gravitational approach of widely diffused matter in a primitive state of rest, for which "state of rest" we have surely no evidence. On the contrary, all analogy (all we observe in the skies now) goes to indicate that the matter whose collision formed the sun, was originally in motion. If this primordial motion naturally contributed to the heat developed at the concussion of such moving matter, whose encounter generated the solar heat: then any store of heat that geological time may require, could have been irrefragibly produced at the sun's formation.

[1] In a letter in "Nature," March 28, 1878, p. 243, on "The Age of the Sun's Heat in relation to Geological Evidence," an analogous solution to the above difficulty was offered by the present writer.

The necessity for the narrow 20 million years' margin, which clashes with geology, is seen then apparently not to have the slightest foundation. It rests on the gratuitous hypothesis that the sun's heat was derived *solely* from gravitation, entailing an approach of matter in a primitive state of repose. The quantity of heat generated under these premises was calculated originally by Helmholtz to suffice for 20 million years of solar radiation.

Moreover, the sun is not yet cooled down: so that a notable part of the 20 million years period, which is the inexorable limit of the above hypothesis, must be spread over *future* time. How much is left for *past* duration of the solar system and for geological history of our globe then? Neptune and Jupiter were certainly shed from the revolving-contracting solar nebula some millions of years before the Earth, *i.e.* before the Earth had a separate existence. Some millions of years must be then inevitably lopped off the other end of our already contracted time-margin. What is left over for the Earth's past existence then: so that on the (exclusive) gravitational hypothesis of the source of the sun's heat, no geological epoch worthy of that name would remain. S. Tolver Preston.

Hamburg, *Dec.* 14, 1892.

THE MOMMOTH AND THE GLACIAL DRIFT.

Sir,—I wish Mr. Jukes-Browne had devoted a little more of his last letter to Geology and a little less to offensive personalities. To these latter I do not propose to reply. What is alone interesting to your readers in this correspondence is to fix the exact age of the Mammoth, a matter of importance not only to the geologist but more especially to those devoted to the early history of man. To the settlement of this problem Mr. Jukes-Browne's last letter adds nothing. He reverts to two cases he had already quoted, one of them the well-known case at Hoxne, where, as I showed, there is not only no positive evidence forthcoming but which was riddled through and through by Mr. Flower. There can be no doubt whatever that judging by the published evidence the case of Hoxne breaks down. There is some evidence that at that place the drift beds overlie the Mammoth bed. There is none that will bear criticism that they underlie it.

The second case from Burgh, where it was not the Mammoth but the *Elephas antiquus* that was found, I have already criticized.

I must correct a curious delusion of Mr. Jukes-Browne, that on this question I have set myself against the best authorities. The best English authorities on the age of the Mammoth known to me are Professor Dawkins, Professor Geikie and Dr. Hicks,[1] all of whom virtually agree with me, or rather, I with them. The French geologists are almost without exception on the same side, while among the geological surveyors, to whom perhaps Mr. Jukes-Browne limits "authority," Mr. Lamplugh and Mr. Skertchly have been liberally quoted by myself, but as a mattor of fact authority has and ought to have very little place in geology any more than in any

[1] See Dr. Hicks's letter.—Edit. Geol. Mag.

other science. Well attested facts and sound logic, combined if possible with literary courtesy, these are what, I am sure, your readers wish, and whoever brings them to your mill and helps to establish truth or sweep away error will be welcomed.

I trust I have avoided saying anything of which Mr. Jukes-Browne can complain, for I have profited a good deal from what he has written elsewhere. I have no wish to exchange sharp words.

ARLEY HOUSE, LYTHAM, NEAR PRESTON. HENRY. H. HOWORTH.
December 10th, 1892.[1]

THE MAMMOTH AND THE GLACIAL DRIFT.

SIR,—The tone which Mr. Jukes-Browne has thought it advisable to adopt in his attacks on Sir Henry Howorth, in recent Numbers of the GEOLOGICAL MAGAZINE, does not, I hope, commend itself generally even to the official mind, still less will it to those who, like myself, believe that it always has been and will still be to the advantage of geological science that it should be cultivated by others than those who have been made geologists by Act of Parliament, or who have adopted it as a profession.

Pending the appearance of the "man who has acquired an insight into the subject by long experience and by approved practical work in the field," (he does not say by whom or by what authority the work is to be approved) who will some day settle the question "beyond dispute." I should like to ask Mr. Jukes-Browne by what rule of evidence could he expect Sir Henry Howorth to accept "as final" the imaginary case he cites, viz. "Gravels with Mammoth bones resting on Boulder-clay." Surely in the first place he should point out a typical case, so that an opportunity may be given for critically examining the evidence. But let it be granted that he could point out such a case, how is it to be proved that the remains, which are those of land animals, are to be considered as of contemporaneous age with the gravels, and not as having been derived either from an earlier deposit, or directly from an older land surface? The only evidence that could be conclusive would be the finding of Mammoth remains, *in an undisturbed state*, on an old land surface with undoubted glacial deposits below it: such a surface as that on which the Endsleigh Street remains were found, but not having, as there, only pre-glacial beds below but some typical glacial deposits instead.

I have already pointed out that Mammoth remains were found by me in caverns in the Vale of Clwyd, under undoubted glacial deposits. I have this year obtained a fragment of a tibia of a Mammoth from the Lower Glacial Gravel at Finchley in a section where a great thickness of Chalky Boulder-clay, containing the well-known derived fossils, reposed on the gravel. The Endsleigh Street evidence, in my opinion, is equally conclusive in showing that the Mammoth lived there early in the Glacial period. The foregoing and similar cases which have been recorded can only *prove* that the Mammoth lived in this country, or in the districts in which the remains were found, during a part of or before the Glacial period.

HENDON, *Dec.* 8, 1892.[1] HENRY HICKS.

[1] Publication delayed by special request of Correspondents.—EDIT. GEOL. MAG.

GRANITE.

SIR,—I can only express amazement that such a paper as that of Mr. T. R. Struthers on Granite (GEOL. MAG. 1892, p. 561–4) should have been written in the year of grace 1892.

Mr. Struthers begins by attributing to geologists the absurd theory that the supposed granitic foundation of the Earth's crust was formed after the overlying crust itself. A perusal of pages 86 to 88 of Rosenbasch's paper "Zur Auffassung des Grundgebirges"[1] would have shown the groundless nature of this statement.

Then follows a delicious example of a *non sequitur* in the observation "that erupted rocks, whether volcanic or trappean,[2] have apparently been derived from granite, for in common with them it consists mainly of silica, alumina, potash, soda, lime, magnesia, and iron." Why granite, to the exclusion of syenite, diorite, gabbro, peridotite, etc., is to arrogate to itself the honour of being the mother of all erupted rocks is not even supposed to require explanation.

Then we have a quotation of a most unfortunate remark of Beete Jukes (no page or reference given; I find it in the 2nd edition of his Manual of Geology, 1862, omitted apparently in the 3rd edition, 1872), from which Mr. Struthers evidently concludes that any lava stream, of no matter what chemical composition, could be traced within the earth to granite. Let the petrologist imagine tracing a limburgite lava stream to a granite magma.

Mr. Struthers states that "the hydrothermal conditions under which granite was formed . . . were peculiar to a particular period of the world's history, when a sea of high temperature overspread its entire surface before any dry land had appeared." Anything more contrary to known facts than this statement can hardly be imagined. The Dartmoor granite and the Brocken granite alter rocks of the Carboniferous period. Does Mr. Struthers suppose that no dry land had appeared at that period or that the fish of those days swam about in boiling water?

He has no hesitation in saying (apparently only from the examination of Lyell's figure (Elements, 1874, p. 552) that the granite of Sharp Tor, Cornwall "is a fine example of bedded granite originally discharged in successive submarine sheets."

Unfortunately Lyell does not state the scale of his drawing, otherwise Mr. Struthers would probably see the untenable nature of his interpretation of the well known mural weathering of granite. An examination of the rock of the apparent pile in question would probably show under the microscope complete continuity in the unweathered portions between the seemingly separate lenticles. If Mr. Struther's interpretation of mural weathering were correct the lenticles should be of immense size, whereas every one practically acquainted with the subject knows that they thin out or are discontinuous usually in a distance of a few feet. BERNARD HOBSON.

OWENS COLLEGE, MANCHESTER, *Dec. 19th*, 1892.

[1] Neues Jahrbuch für Mineral, 1889, Bd. ii.

[2] Mr. Struthers still classifies rocks into, among other groups, "trappean" and actually calls syenite a trappean rock.

3000 FEET OF QUATERNARY AND ?TERTIARY DEPOSITS IN TEXAS, U.S.A.

SIR,—At Galveston, Texas, a well has recently been bored (in search of water for a city supply) in which the following formations are reported (in the New York "Engineering and Mining Journal") to occur. This well is said to be the deepest on the sea-coast of the United States.

From surface to	46 feet	.....	Grey sand.
Thence to a depth of	64 ,,	.....	Red clay and shells.
,,	100 ,,	.....	Blue clay, sea shells, and rotten wood.
,,	315 ,,	.....	Sands and sea shells.
,,	815 ,,	.....	Sand and clay.
,,	1288 ,,	.....	Sand, clay, sea shells, and decayed wood.
,,	3070 ,,	.....	Varying strata of sand, clay, and large logs.

At very bottom of hole a bed of Sea shells was struck.
The diameter of the hole varied from 15 to 6 inches.
No water and no rock were encountered.

Perhaps this may meet the eye of someone who can supply more detailed information in regard to this interesting section, and say something as to the nature of the sea shells, fossil wood, etc., brought up.

W. S. GRESLEY.

ERIE, PA., U.S.A., *6th December*, 1892.

"THE MALVERN CRYSTALLINES."

SIR,—May I be allowed to make one or two brief remarks on the criticism of my friend, Dr. Calloway, in this month's number of the GEOL. MAG.

While attaching a very high value to his work, I still fancy I have broken new ground to some extent by presenting the case of the Malvern Crystallines as a *physical* problem to be attacked, first of all in the light of the field-evidence, for observing and collecting which I had exceptional opportunities in the early part of the year. I may say that his general omission from consideration of the chemical and physical factors of such a problem takes the sting out of many of Dr. Calloway's criticisms. I cannot regard it as a valid criticism to quote from what is little more than a note in Prof. Phillips' later work, as if it neutralized the value of the speculations of his earlier work, to which I referred. It does not alter my estimate of the value of his earlier views, which went so far in anticipation of some recent advances in petrological science. Does Dr. Calloway think he is appealing from Phillips' drunk to Phillips' sober? Nor does a negative deduction from Dr. Callaway's general experience of the Malverns do much to damage a case specifically cited by me in the quarry above West Malvern Church. Creditably again is so variable a factor with different minds, that such a retreat from the objective to the subjective does not appear to me to be of a very high order of scientific reasoning. The puzzling case of the hornblende and the two felspars mentioned on p. 546 seems to me (so far as I can follow the description) to admit of an easy explanation as a case of pure and simple segregation as crystallization progressed in the mass, if the variable fluxing-action

of the different bases is fully considered, and to which I have drawn attention in my paper.

I do not for a moment pretend to have reached the end of my studies of this interesting complex of rocks, and shall await with much interest the appearance of the promised paper. As to my 'shear-planes' (not 'shear-zones'), it is just *because they have nothing to do with the 'schist-making' processes*, that they afford such strong *negative* evidence (while they record the action of dynamic forces on a grand scale) against the notion of the schist-manufacture having been wrought generally in *solid* crystalline masses. The general principles of my work are sufficiently before the world for those who care to know them to do so.

Wellington College, Berks, 16*th Dec.*, 1892. A. Irving.

GLACIAL GEOLOGY.

Sir,—I quite agree with Mr. R. M. Deeley in your last number, when he writes that he has "read with much interest the papers by Mr. Mellard Reade and Mr. Percy Kendall in your July and November issues. On the one hand we have the submergence theory proved up to the hilt, and on the other, the glacier theory sustained with equal show of reason. Does it strike the combatants that they may both be right and both be wrong?"

It is difficult to conceive a Glacial Period without the usual phenomena appertaining to both land and coast ice. Why should we, therefore, restrict ourselves to either the one agency or the other, when there must have been marine and land moraine drifts contemporaneously forming. The Gloppa deposit at Oswestry described by Mr. Nicholson in the Q.J.G.S. Vol. xlviii. p. 86 may be taken as a typical marine drift with its glaciated lake district erratics and Boreal Fauna of recent shells, occurring from 1070 to 1120 feet above O. D., yet twelve miles to the north-west of the Gloppa in the upper valley of the Dee from the neighbourhood of Corwen to Bala Lake, which is only 540 feet above O. D.—the drift is entirely local and does not contain any fragments of recent marine shells, though 500 feet below the Gloppa deposit.

The plain interpretation of this—to my mind—is that ice filled the upper valley of the Dee and the surrounding country to a higher level than that to which the marine drift of the Gloppa obtained. The Gloppa deposit like the other deposits of high level marine drift as Moel Tryfean, Macclesfield, and Halkyw (Flintshire), are situated upon the outskirts of the mountainous areas to which they belong. This, I think, would suggest that such mountainous areas were covered with a thickness of ice in their central portions, which excluded the high level marine drift from the interior mountains and valleys. William Shone.

Upton Park, Chester, *Dec.* 16*th*, 1892.

OBITUARIES.

JAMES ARMSTRONG, FORMERLY OF GLASGOW.

BORN JANUARY 1, 1832. DIED NOV. 28TH, 1892.

JAMES ARMSTRONG was born at Leith, on the Firth of Forth, Scotland, but was educated at a Normal School in Glasgow, where, at an early age, he was sent into a business office. He had from his youth a keen desire for study, and joined an evening class at Anderson's College, Glasgow, under Dr. Taylor, professor of Natural History. Soon afterwards he, with a few of his colleagues, founded the now well-known Glasgow Geological Society, of which he was for many years its Recording and Corresponding Secretary, and Editor of its Transactions. Mr. Armstrong was an ardent Collector of fossils, especially those of the Carboniferous rocks, and he was one of the best authorities upon the fossils of this formation in the West of Scotland.

In conjunction with Mr. John Young, F.G.S., of the Hunterian Museum, Mr. Amstrong published in 1871, a "Catalogue of the Carboniferous fossils of the West of Scotland," printed by the Geological Society of Glasgow. Later (in 1876), with the assistance of John Young and David Robertson, F.G.S., and Professor J. Young, M.D., these geologists brought out an admirable little work, being a "Catalogue of the Western Scottish Fossils," with figures of the Moffat Graptolites by Prof. Lapworth, and an admirable Bibliography, printed and published at the expense of the Local Executive Committee of the British Association for the Glasgow Meeting, 1876. Mr. Armstrong's private collection was one of the best illustrations of the palæontology of the Glasgow area, and is now preserved in the Museum of Science and Art, Edinburgh, while a small part is in the Cabinet of Dr. Hunter, of Carluke, Lanarkshire. Mr. Amstrong was a Member of the Glasgow Philosophical Society, of the Edinburgh Geological Society, &c. He died at Brooklyn, New York, U.S.A., on the 28th November, 1892.

PROFESSOR JOHN STRONG NEWBERRY, M.D.,

FOR. MEMB. GEOL. SOC. LOND.,

BORN DECEMBER 22, 1822. DIED DECEMBER 7, 1892.

PROFESSOR J. S. NEWBERRY, of Columbia College, New York, whose death we regret to have to record, was born seventy years ago at New Windsor, Connecticut, and removed early in life to Cuyahoga Falls City, in Ohio. He was educated for the medical profession, and graduated in 1846 at the Western Reserve College, and afterwards at Cleveland Medical College in 1848. He travelled in Europe in 1849–50, and entered upon private practice as a physician at Cleveland, Ohio, in the year following.

Newberry was imbued from childhood with a taste for Natural

Science, and the routine of his profession soon proved too irksome. In 1855 he determined to devote all his time to scientific work, and started as surgeon, geologist, and naturalist to the Government expedition under Lieut. Williamson, engaged to explore the country between San Francisco and the Columbia River. Newberry soon after published his first work on "The Geology, Botany, and Zoology of North California and Oregon." In 1857–58 Newberry explored the now well-known cañons of the Colorado River, and shortly after prosecuted his geological researches in New Mexico, Arizona, and Utah.

Newberry's distinguished services were rewarded in 1866 by the post of Professor of Geology in the School of Mines, Columbia College, New York, and two years later he was made State Geologist of Ohio, when his more systematic scientific work began. The reports of the Geological Survey of Ohio, published under his direction, contain not only stratigraphical and economic geology, but also monographs on palæontology of great value. The descriptions of the Devonian and Carboniferous fishes and plants were contributed by Newberry himself; and these, with subsequent writings on the same subject, led to an entirely new view of the gigantic "placoderm" fish, *Dinichthys*, of the Devonian period. His unique collection has been placed in the museum of Columbia College.

Although Professor Newberry continued his lectures and classes until two years ago he nevertheless found time to pursue his favourite studies on Palæozoic and Mesozoic fishes and plants, and in 1888 and 1890 he issued two large monographs under the auspices of the United States Geological Survey. The first volume relates to the Triassic fishes and plants of New Jersey and Connecticut, and the second deals with various Devonian and Carboniferous fishes, each containing a synopsis of earlier researches, combined with new figures and many observations not previously published. These works will ever remain standards for reference, and the mine of clearly-enunciated facts they contain will form an enduring monument of the author's industry and acumen. Even until the last, Dr. Newberry was contemplating a supplementary volume on the Palæozoic fishes, and he had nearly completed a Monograph on the Cretaceous flora of New Jersey.

Dr. Newberry was one of the founders of the United States National Academy of Sciences, and occupied the Presidential chair of the New York Academy of Sciences from 1867 until 1891. In 1867 he presided over the meeting of the American Association at Burlington. In 1883 he became a Foreign Member of the Geological Society of London, and in 1888 he received the Murchison Medal awarded by that Society. Whether in his quiet home at New Haven, or in the Museum of Columbia College, or wandering abroad, the privilege of meeting Dr. Newberry was one to be cherished. He was truly esteemed by all who came in contact with him, and the memory of his friendship will long be treasured, both by his students and fellow-workers.